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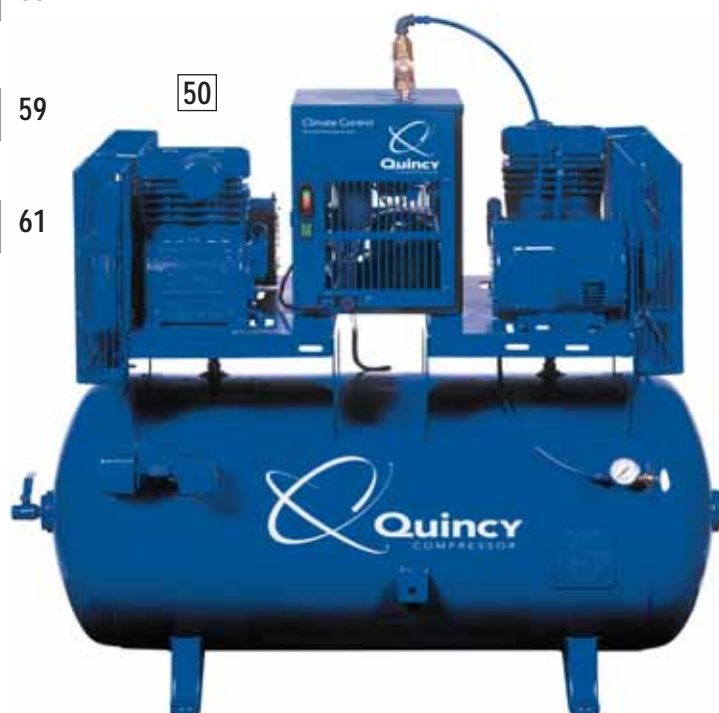
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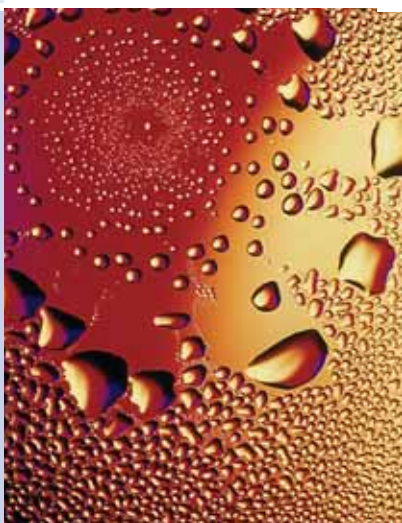
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FROM THE EDITOR

Learning



How much do we learn every day, week, month, or in a year? Do we enjoy learning or is it “work”? Do we already know everything? Do we know what we don’t know? Have you ever looked at a specific topic, let’s say compressed air for example, and tried to determine, on a scale of 1–10, where your knowledge level is? What is it you can still learn about? Do you have learning goals with a time table?

These are not normally conscious decisions. They are a result of what we choose to do or not do with our time. I remember calling home once to confess having received mediocre grades that semester in college. My father, who was a college professor at the time, asked, “why do we send our people to their best learning opportunity at the precise moment their body and mind has the least interest in learning”? We may think we are too busy to learn more or have other things on our minds. We may simply be satisfied with our knowledge levels, for better or worse.

Mr. Scot Foss, in these pages, extends a challenge to people to accept the fact that today “we have to do more with less, or else”. How true. Implied in this statement is that we must continually learn new things in order to keep up in this world, which places ever-greater demands on our personal and professional lives. Only by learning can we identify ways to become more efficient.

As a new publication, we are learning a tremendous amount and enjoying every day of it. We are learning a tremendous amount about compressed air. At the NPE 2006 Plastics Show in Chicago, we saw a new compressed air dryer, which I had never dreamt of before. A dryer engineer had learned enough about the plastics industry, that he created a new product! An integrated compressed air and plastic resin dryer — a true innovation. The Show Review has more details. It’s a great example of what happens when you are open to learning new things.

Thank you for the many calls with support and suggestions. Both are equally valuable for our learning process. Some of the feedback we’ve received has been:

- “The technical quality is very strong in the magazine. We learned something we can use. Keep it up!” This has been a strong reinforcement for us on the editorial side.
- “Subscription prices are too high, for as many people to read it as we’d like”. We learned something here as well. Please note our new, lower rates.
- “We’d like to see a Ask the Expert section where we can get advice on situations in our factory”. Please see the below box.

We hope you are allowing yourself the opportunity to learn and that Compressed Air Best Practices Magazine can be a helpful resource for you.

ROD SMITH

ASK THE EXPERT

Send us your questions to rod@airbestpractices.com and a compressed air system specialist will respond.

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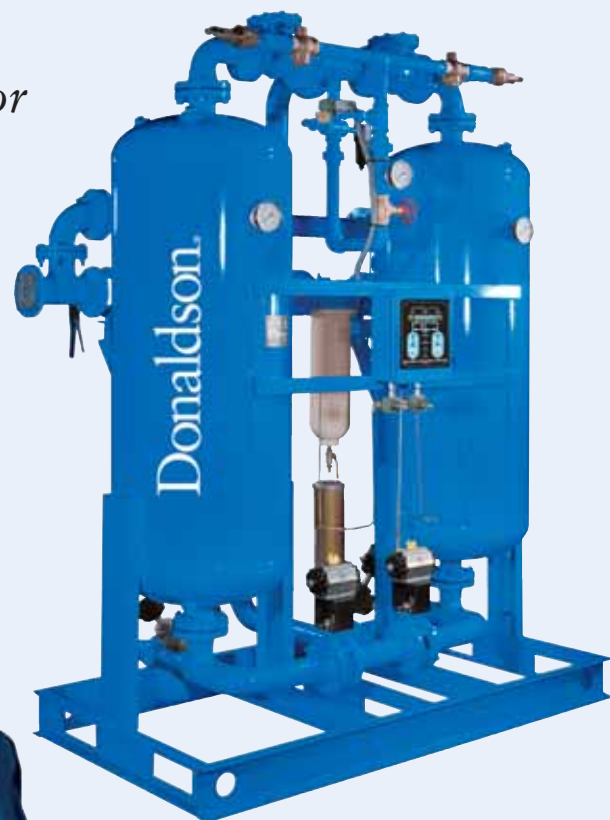
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THE COMPRESSED AIR CHALLENGE™

Interview with David Terry (Executive Director)

and Aimee McKane (Project Development Committee Chair) of the Compressed Air Challenge™

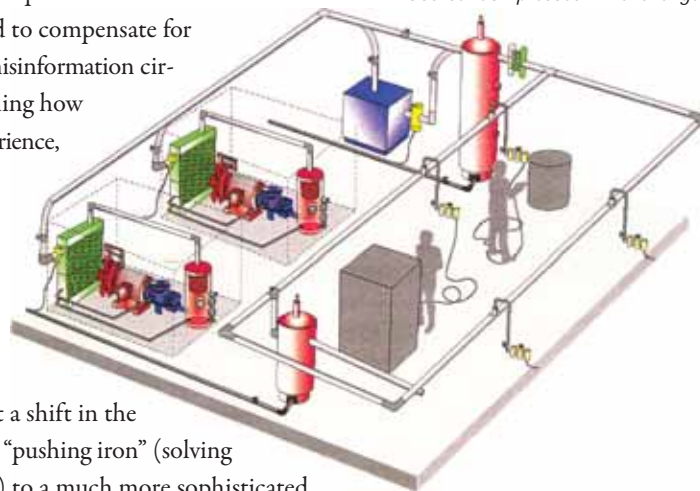
COMPRESSED AIR BEST PRACTICES: What is the Compressed Air Challenge™ and why was it formed?



Aimee McKane

THE COMPRESSED AIR CHALLENGE™: The Compressed Air Challenge™ (CAC) was formed in 1997 as a voluntary organization to promote greater energy efficiency in U.S. industrial compressed air systems, with a specific focus on education. The idea for the CAC emerged from a series of discussions with compressed air users, equipment manufacturers and dealers, electric utilities, and state and national energy efficiency organizations. The U.S. Department of Energy (USDOE) provided the initial support to form the CAC initiative because they saw a large opportunity for energy savings. Virtually everyone was telling us that these systems were not set up to operate efficiently, that the market operated on lowest first cost, that many systems were seriously oversized to compensate for poor control, and that there was a great deal of misinformation circulating among both buyers and sellers concerning how these systems should work. From our shared experience, we felt that American industry could be much better served — both in terms of energy use and cost, as well as system reliability. So we set out to change the way the market worked.

*Compressed Air must be treated as a "system."
Source: Compressed Air Challenge™*



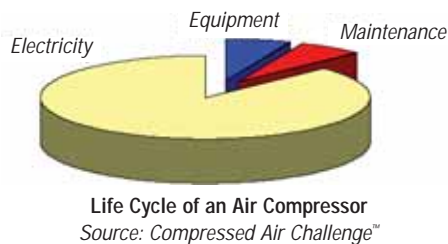
Wasn't that a pretty large undertaking?

Yes, it was. What we were trying to do was start a shift in the market from what was commonly referred to as "pushing iron" (solving pressure problems through adding compressors) to a much more sophisticated approach based on providing a full range of compressed air system services. Alone, no single organization could have done it. What the CAC provides is a unique platform for multiple stakeholders (compressed air end users, utilities, energy efficiency organizations, equipment manufacturers and distributors, and government) to work together on a common goal. We started with 12 sponsors and currently have 15, including most of the original ones. The CAC recently expanded into Canada with the addition of BC Hydro and Manitoba Hydro as sponsors.

How does a group this diverse get things done?

The participants in the CAC all bring one common interest to the table — a desire to improve the energy efficiency of industrial compressed air systems. Very early on, we decided to stick to a few guiding principles. First, we would remain product-neutral. That is, we would present information that was technically accurate but did not promote one product over another. Second, we would strive to reach a technical consensus on any information that was released under the CAC logo. I say "strive," because although we occasionally need to agree to disagree, overall we do a pretty good job of achieving balance. Finally, most of the technical input into our training and publications has been made on a voluntary basis. The CAC operates on a shoestring. Without the extremely generous contributions of time and knowledge from our technical experts, we wouldn't be here today.

THE COMPRESSED AIR CHALLENGE™



“After the training, 76% made some type of capital or operating improvement to their compressed air system”

What impact has the CAC had so far?

We are very encouraged by the differences we see today on the supply side in the compressed air industry. The market has truly been transformed in the types of products being sold and the way they are offered to industry. The greater awareness of energy costs, associated with compressed air, has been supported by most manufacturers who have developed many new products designed to increase system efficiency. Compressor distributors have invested in training their sales engineers and acquiring the measurement and analysis tools necessary to make compressed air system assessments — before quoting equipment.

This has led to an industry-wide effort to educate compressed air users. The CAC has had the biggest impact in states and regions such as New England, Iowa, Wisconsin, North Carolina, and the Pacific Northwest, where energy-efficiency organizations and utilities have teamed with distributors and equipment manufacturers to bring the system message to air users.

What types of training programs, for compressed air users, does the CAC offer?

The CAC offers three training programs:

1. Fundamentals of Compressed Air Systems
2. Advanced Management of Compressed Air Systems
3. Qualified AIRMaster+ Specialist Training (together with USD OE)

The USD OE did an independent study of our training programs to judge their effectiveness. Some of the findings were:

- Attendees are primarily plant engineers, chief electricians, and maintenance managers with some direct supervision over the compressed air systems at their facilities
- After the training, 76% made some type of capital or operating improvement to their compressed air system
- After the training, 50% implemented changes to their compressed air maintenance procedures
- Project payback periods for measures, other than compressor replacements, were 1.8 years
- Non-energy benefits were found by 76% of the attendees. These included reduced downtime, reduced contamination in the system, and more consistent system pressures.

The CAC is actively engaged in offering training, in conjunction with utilities, industry, government, and energy-efficiency organizations. The CAC is also developing new training products. Additional training hosts are always welcome and can obtain hosting information on the CAC web site.

What types of educational materials and products does the CAC offer?

Thousands of hours have been donated to the CAC by member organizations and individuals in order to create some very valuable educational resources. They are all available at www.compressedairchallenge.org and include:

1. Best Practices for Compressed Air Systems*
2. Guidelines for Selecting a Compressed Air System Service Provider
3. Improving Compressed Air System Performance: A Sourcebook for Industry**
4. Energy Tips for Compressed Systems**
5. An Assessment of the Market for Compressed Air System Efficiency Services**
6. AIRMaster+ system assessment software**

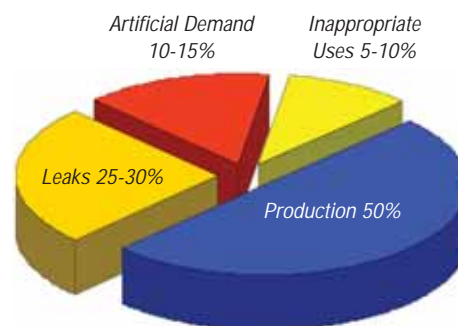
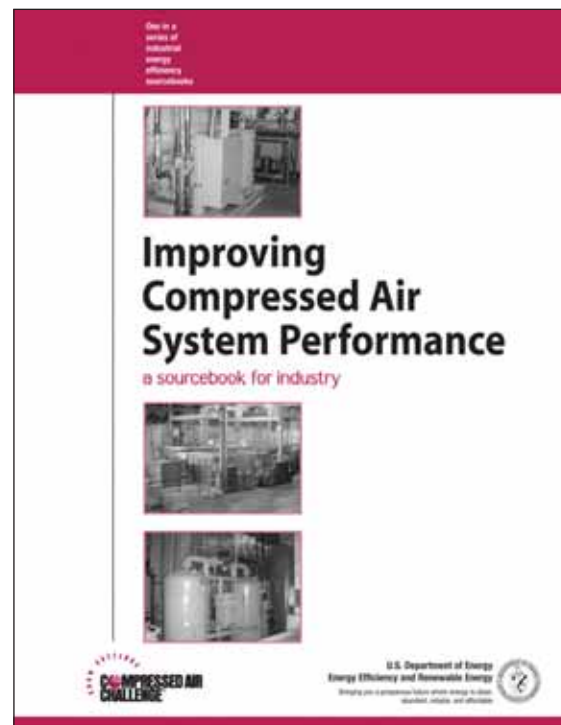
**Developed in conjunction with the USD OE

Any new tools and publications coming this year from the CAC?

Sure! We have a full slate this year with some of the projects covering:

- The development of an import tool — “LogTool” — designed to enhance the usability of AIRMaster+ by making it much easier to import information from data loggers. LogTool will be available, together with updated AIRMaster+ software, in late summer, 2006
- Production Floor Training, designed as a follow-along activity for participants in CAC training, to assist them in bringing the CAC message to their plant and as an aid to implementing the 7-Step Action Plan. This training will link the trainee with a CAC instructor to make an awareness presentation to production floor workers. This product builds on a pilot program developed by Weyerhaeuser and a CAC sponsor, the Northwest Energy Efficiency Alliance
- Publication of a document describing two different levels of analysis for compressed air systems — to help define the market for these services
- An updated edition of Best Practices for Compressed Air Systems*

All projects developed by the CAC depend on the support of individual sponsors, over and above the minimum annual dues. Additional sponsorship support is always welcome.



Typical Components of Demand
Source: Compressed Air Challenge™

*No relationship to Compressed Air Best Practices Magazine

THE COMPRESSED AIR CHALLENGE™

Aside from receiving training, how can energy managers and air users get involved with the CAC?

Back when the CAC was formed, we didn't approach compressed air users to become sponsors because we wanted to engage them in participating in the training. We now think that this involvement is essential. Participation in the CAC enables compressed air users a direct voice in discussions concerning what projects the CAC should undertake, as well as helping to shape their development. Participants also have the opportunity to interact with the leading experts in the compressed air industry. We have two active members of the CAC from Ford and Weyerhaeuser who are organizing an End Users Group to provide essential input into the work of the CAC from a range of industrial sectors. Participation does not require any travel. An energy manager or other end user with an interest in improving the energy efficiency of compressed air should contact Doug Woodward doug.woodward@weyerhaeuser.com or Joe Ghislain jghislai@ford.com.

What is the future of the CAC?

When the CAC was incorporated as a 501(c)3 organization in 2000, it went from a short-term activity to an independent organization. Next year, the CAC will celebrate its 10th anniversary, which was something that many of us involved at the beginning never expected. To a large extent, the supply side of the compressed air market transitioned to a systems services approach, but we still need to complete the job of educating the compressed air user. We have trained approximately 6,000 compressed air users since we first launched our training in 1998, but the U.S. alone has about 200,000 factories, most of whom use compressed air. We recognize that not everyone can attend a one- or two-day training, so we are looking for new ways to broaden our reach. Several of the CAC's new initiatives are designed to do this, including the End User Group and Production Floor Training. As part of the Production Floor training, we will need to engage plant managers, which is critical for successful implementation of projects to improve compressed air system efficiency.

Over the next several years, the CAC plans to continue our educational mission by developing top-quality educational materials. We are also interested in strengthening our relationship with organizations that promote the energy efficiency of other industrial systems.

How can one become active in the CAC?

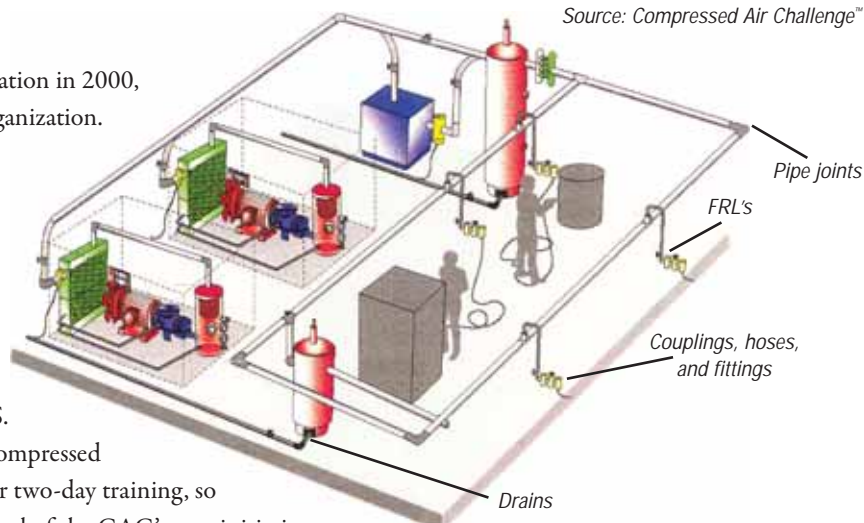
If you would like to host a CAC training session, sponsor a project, or otherwise participate in the CAC, we'd be pleased to hear from you.

For more information visit <http://www.compressedairchallenge.org/> or contact:

David Terry, Executive Director, Compressed Air Challenge™, email: dterry@statelineenergy.org

Aimee McKane, Chair, CAC Project Development Committee, email: ATMcKane@lbl.gov

Common Leak Locations
Source: Compressed Air Challenge™



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ENERGY STAR[®] FOR INDUSTRY

Interview with Elizabeth Dutrow of EPA's ENERGY STAR Program

COMPRESSED AIR BEST PRACTICES:

What is ENERGY STAR?

ENERGY STAR: ENERGY STAR, introduced by EPA in 1992, is a voluntary, market-based partnership whose mission is to reduce greenhouse gas emissions through increased energy efficiency. ENERGY STAR helps us all save money and protect the environment. ENERGY STAR has become a national symbol for energy efficiency. Independent surveys indicate that 60% of the U.S. public now recognizes ENERGY STAR as a symbol for energy efficiency. ENERGY STAR is a national brand, owned and managed by the EPA. This unique situation enables it (the ENERGY STAR brand) to influence many product classes and industries.



When did it start and what areas does it cover?

EPA introduced ENERGY STAR in 1992 with the goal of reducing greenhouse gas emissions through energy efficiency. EPA tested the concept of offering an energy-efficiency label for recognizing efficient performance on one type of product, the personal computer. PCs, which could be improved to carry the power-saving “sleep” function, first bore the ENERGY STAR.

Since that time, ENERGY STAR has grown to work together with more than 8,000 organizations across the U.S. The ENERGY STAR can be found on new homes, products, U.S. building’s and in the area of industrial energy management.

In 2005 alone, Americans, with the help of ENERGY STAR, saved enough energy to avoid greenhouse emissions equivalent to those on 23 million cars — all while saving \$12 billion on their utility bills.

How is ENERGY STAR organized for building energy management?

On the building energy management side, the ENERGY STAR can be earned for schools, hospitals, office buildings, supermarkets, and other types of facilities. Building management firms can now look at their real estate holdings and evaluate how energy-efficient they are. Buildings that score at the 75th percentile of energy performance, based upon a rating from EPA’s National Energy Performance Rating System, and which are professionally verified to meet current indoor environment standards are eligible to apply for the ENERGY STAR. EPA awards a bronze plaque to provide a facility recognition of its superior energy performance. This can be renewed on an annual basis, provided that a building’s energy performance remains at the 75th percentile or better.

So tell us about ENERGY STAR for Industry?

ENERGY STAR has established partnerships with 450 manufacturing corporations. Our focus is centered on promoting superior corporate energy management. Many plants have difficulty executing energy-saving programs, without corporate support, and this is why we start the process at the corporate level. Corporate involvement also enables easier communication between plants on what is working and what isn’t.

ENERGY STAR assists with the development of strong energy management programs. The “Teaming Guide” is a tool we offer, for example, to provide guidance on how to assemble an energy team. This guide makes the case that process engineers, environmental engineers, finance, plant management — everyone has a role to play in managing energy. We assist with establishing standard energy measurement practices across facilities. These enable a clearer understanding of the situation and provide management with the information needed to make decisions. This differs from Lean Manufacturing in that it has a narrower focus on energy. It is a bit similar to an ISO 9000 process of documentation and measurement of what you do with regard to energy management.

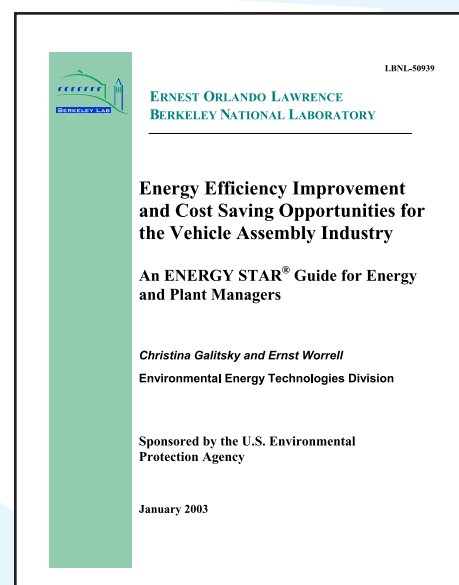
We then create momentum within specific industries with ENERGY STAR Industrial Focuses. Focuses provide industry-specific energy management tools and resources, develop the corporate structure and systems to better manage energy, and reduce energy use within an industrial sector.

What are your “Focus Industries”?

The Focus Industries today are breweries, cement manufacturing, corn refining, motor vehicle manufacturing, petroleum refining, glass manufacturing, food processing, and pharmaceutical manufacturing. We have found that while participation is voluntary, most companies within an industry are active in the Focus. There are three main activities and tools used by the Focus Industries:

1. Focus Industry Forums: EPA gathers an industry’s energy managers once a year for information sharing. These energy managers, who normally haven’t known each other, are facing similar problems. ENERGY STAR works with the companies in the industry to help them set up energy management programs or improve existing ones.
2. Energy Guide: This guide is a resource on trends in energy use and energy intensity in a specific industry as well as a systematic analysis and discussion of the energy efficiency opportunities in the manufacturing plants. Energy Guides are developed by EPA through support from researchers at the Lawrence Berkeley National Laboratory and the focus industry. Energy Managers use the guide to:
 - a. Identify areas for improvement
 - b. Evaluate potential energy improvement options
 - c. Develop action plans and checklists for the energy program
 - d. Educate company employees
3. The Plant Energy Performance Indicator: This tool enables energy managers and corporate executives to evaluate the energy efficiency of their plants relative to that of their industry.

“ENERGY STAR
helps us all
save money
and protect
the environment.”



Energy Guide for Vehicle Assembly Industry

EPA'S ENERGY STAR PROGRAM

Can you elaborate on the Plant Energy Performance Indicator (EPI)?

Benchmarking energy use is one of the most important elements of a sound energy management program. Benchmarking empowers corporations to set goals for improvement and monitor progress. The ENERGY STAR plant EPI is a benchmarking tool.

Managers input key plant operating data to receive an energy-efficiency rating for a plant on a scale of 1 to 100. The EPI is derived from nonpublic data collected by the Census Bureau. It is developed by the EPA through the analytical support of Argonne National Laboratory. It is a critical management tool for evaluating how efficiently a plant is using energy in comparison to the industry nationwide. In addition to reporting a score for the plant, the EPI also provides information on the average and "efficient" plants in the U.S. EPA defines efficiency as the 75th percentile of all plants.

"ENERGY STAR makes its industrial partners aware of any Department of Energy resources such as the Compressed Air Challenge."

For which industries has ENERGY STAR developed an EPI?

For it to be valuable and actionable, we have found that the EPIs must have a very narrow focus for a specific industry. We currently have one EPI completed for automotive assembly plants. Energy managers in this industry can now rate their plants' energy use per assembled vehicle. They can also determine how their energy use compares to their industry through the percentile rating.

EPA will announce the release of two new EPIs at the World Energy Engineering Conference in September. These will be for cement plants and wet-corn milling facilities. Two future EPIs, being worked on now, are for glass plants and for facilities engaged in canning and freezing of vegetables and fruits.

May we assume that compressed air management plays an important part of these programs?

Absolutely! Compressed air, as you know, plays a critical role in most of our focus industries. When asked about specific topics in a facility, ENERGY STAR makes its industrial partners aware of any Department of Energy resources such as the Compressed Air Challenge. For example, the ENERGY STAR Focus on Energy Efficiency in Cement Manufacturing has highlighted available resources for managing compressed air so that cement plants can use them to improve performance.

How can a company become an ENERGY STAR Industry Partner?

We ask that the CEO or CFO of a corporation sign a partnership letter and send it to the EPA. This letter is located on our Web site at www.energystar.gov/join. The partnership letter expresses a commitment from the Industry Partner to do four things:

1. Commit to continually improve energy performance
2. Baseline, track, and benchmark energy performance for all facilities
3. Develop and implement a plan to reduce energy use
4. Educate company staff and the public about the ENERGY STAR partnership

We encourage companies to become ENERGY STAR Industrial Partners. Energy efficiency is important for the environment and for company performance. After all, the cost of energy saved can be substantial and can keep the company competitive.

Thank you, ENERGY STAR.

For more information contact: Elizabeth Dutrow,
EPA ENERGY STAR. Phone (202) 343-9061,
Email: dutrow.elizabeth@epa.gov,
Web site: www.energystar.gov.



**CHANGE FOR THE
BETTER WITH
ENERGY STAR**

OPTIMIZING THE COMPRESSED AIR SYSTEM

BY R. SCOT FOSS

“The opportunities of reducing operating cost and energy in air systems is typically more than 50%.”

Compressed air represents one of the most critical utilities in most production and process environments. The efficiency of a compressed air system is 100% energy in and, when perfect, produces 11% useful work out. Understanding this, it will cost more to operate a compressor in the first year than it costs to buy and install. Despite this harsh information, power is thrown at symptoms of undefined problems every day. The opportunities of reducing operating cost and energy in air systems is typically more than 50%. This article will carve out a plan of attack to optimize the supply and demand systemically and yield the lowest demand at the highest rate of standard cubic feet per kilowatt of energy.

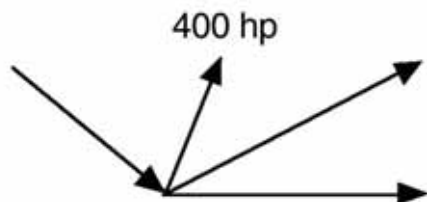
There are a number of essential actions that need to be taken to optimize the compressed air systems. You need to minimize demand, control the expansion of the air, distribute it while minimizing energy loss, store potential energy, and compress the air efficiently. Other than operating the compressors as efficiently as possible, everything else seems to elude most everyone. This work cannot be done theoretically on each piece of equipment only in the compressor room. It must be done systemically. More efficient compressors make more air with the same amount of power. They cost more and can be an important part of a well-operated system. On the other hand, if you throw a more efficient compressor at a highly inefficient system, you will waste more air at the same operating cost and save nothing.

Controlling Demand in the System

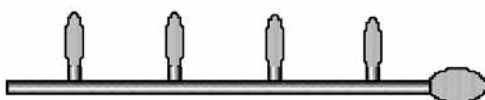
- A. Control the expansion of the compressed air to the point of use. You must control 100% of users with regulation, which is adjusted lower than the lowest supply pressure. If it is not possible to achieve this with operator discipline, then you must use a demand controller or expander at a central location adjusted in the same manner.
- B. Reduce the pressure differentials on installation components such as filters, regulators, lubricators, tube, hose, and disconnects on the demand side of the system. The intent is to operate demand at the lowest possible supply pressure on critical high-pressure applications.
- C. Flat-line the high rate of flow, intermittent applications with dedicated storage, and metered recovery. This is much like a battery charger or water tower application. This can also be a pressure driver for the operating protocol. You will slightly increase the base usage and eliminate peaks.



OPTIMIZING THE COMPRESSED AIR SYSTEM



“Limit the coincidence of events that cause peak demands in the system.”



- D. Review and add as necessary general and control storage to slow the rate of change in the system. This will enable you to maintain a higher point of use pressure if necessary without increasing the supply pressure. If there is any diligence used, you can normally reduce the supply pressure simultaneously.
- E. Upgrade the quality of information to track progress and improve decision making. This should include a flow meter and demand pressure monitor at the discharge of the demand controller or the expander. If you do not use a demand controller, recognize that demand is only accurately displayed when the demand exceeds the supply. This is referred to as a negative rate of change. When supply exceeds demand, which is a positive rate of change, you are measuring supply response to demand. The system will take whatever supply power you throw at it. A 450 scfm negative rate of change will recover to the original pressure in one minute if we respond with a 200 hp compressor. If we throw a 400 hp compressor at the event, it will recover in 15 seconds at a more rapid rise in pressure. The inefficiency is the part load energy of the larger compressor for the balance of the 45 seconds. If we match the event with a 100 hp compressor, the pressure will hold at the load pressure of the compressor until the event stops, at which time, the pressure will recover at the same rate of rise as the initial rate of decay.
- F. Review and add as necessary general and control storage to slow the rate of change in the system. This will enable you to maintain a higher point-of-use pressure, if necessary, without increasing the supply pressure. If there is any diligence used, you can normally reduce the supply pressure simultaneously.

Reducing Demand in the System

- A. Develop a leak benchmarking program on a gradual reduction of the tolerance volume. Select a level at a known low load, and repair your way to that level. Every several weeks, check the low load and scan the system using an ultrasonic leak detector. Find and repair the largest leaks found to bring the system back into benchmark. When you are comfortable with this level, lower the level and begin again. You will reach a point where there are so many small leaks to fix during the benchmarking period, the labor hours cannot be justified. At this point return to the previous higher tolerance value.

Record the types and nature of the leaks that you are fixing, so that you can leverage this information into buying more leak resistant components and improving best practices installations.

NOTE: It is important that the reduction of demand does not cause the demand pressure to rise. If it does, then other unregulated users will increase at the elevated pressure. That is why it is so important to have demand controls installed before you become aggressive in demand reduction. It is also important to offload a linear amount of supply energy for the demand reductions.

- B. Eliminate all open compressed air blowing applications and replace with low pressure centrifugal or positive displacement blowers, if at all possible. If it is not possible to use blowers, apply specialty air volume reducing nozzles for the application. Take your time with these applications developing the thrust per square inch as close as possible to the open blowing application. You will also need to filter the air for specialty nozzles, as they will easily plug up with pipe debris. Whenever possible, use a solenoid valve to shut off the air on cyclical applications.
- C. Replace all applications, which are poor users of compressed air. Focus on operating cost alternatives. Use electricity whenever possible for its better wire-to-work-energy relationship.

- D. Reduce the size of demand events as seen by the system, including high ramp applications. This can be accomplished by slowing down the introduction of these events into the system. This can be done by opening the demand valve slower manually or automatically. This reduces the “ramp in” rate of flow, so that the supply including control storage can match the event limiting the ultimate pressure drop, which would result.
- E. Regulate all points of use, even if you have installed a demand controller or expander in the main supply system's piping. Make sure that the set points on the regulators are equal to the minimum supply pressure minus the point-of-use filter and regulator pressure drop or less. If you allow for a 2–3 psig margin below this value, small leaks and filter dirt loading will not cause frequent changes in process performance.
- F. Limit the coincidence of events that cause peak demands in the system. This includes minimizing the blow duration on timer drains and adjusting intervals seasonally for relative humidity. Move large events to low load times where possible.
- G. Shut off all air using equipment when not in use. Make sure that the shutoff valves are ergonomically installed, so that operators can easily reach them. If this doesn't work, install solenoid shutoff valves that are tied into the electrical shutoff on the machine, work station, or process.

Store Potential Energy to Support Transient Events, Including a Compressor Failure in the Supply System

- A. Convert enough kinetic energy to potential energy so that you can handle your largest event without turning on another compressor during normal operation. If you do this you will also handle all of the smaller transient events that are not controlled from downstream. This can include the coincidental impact of a third to first shift startup. Remember that storage is a function of the capacity to store air times the useful differential across it. If you are operating constant pressure compressor controls and they operate correctly, no amount of capacitance will generate any useful storage.
- B. Store enough air on the supply side of the system to manage a desired pressure drop, while bringing up a backup compressor to replace a failed one. The intent would be that the event will have no impact on the process or production serviced by the system. The intent is to operate only the supply that is required at any time with everything else off.

Example:

Largest compressor = 1600 scfm,
maximum allowable pressure drop from the
load pressure on the back up compressor =
10 psid, permissive time to load the
compressor from a cold start signal to full
load = 15 seconds, atmospheric
pressure = 14.3 psia, gallons per
scf = 7.48 gallons
 $1600 \times (15/60) \times (14.3/10) \times 7.48 = 4278.6$ gallons

- C. Create enough storage to control the maximum load cycles per time period on any trim compressor. It is safe to say that 3 minute load-unload cycles or longer would be desirable on any positive displacement compressor. This can get trickier on large dynamic compressors, but it is not impossible.
- D. If the size of any event or compressor is too large to handle with control storage or you want to protect the system and production against an electrical outage, single phase, or brown out, offline high pressure peak shaving would be the most desirable approach to minimizing onboard power. It would not be unusual to store 30-40,000 cubic feet of air in a 100 psig differential supported by a 20 hp compressor offline. You would then introduce the air back into the system on a variety of different cues or logic patterns to support the various events.

NOTE: It is the intent of all potential energy applications to either prevent the normal operation of an additional compressor, extend the mechanical life of a compressor or compressors, or both. Well-applied storage will increase the base load in the system slightly, and eliminate the requirement for added compressors during peak plus the inefficient part load in between peaks.

Distribute the Compressed Air, While Minimizing Energy Losses

- A. The concept of design or redesign should be to minimize the highest amount of air mass or volume of air and the distance that the air must flow to support any part of the system from supply to demand.
- B. Resistance to flow is necessary in the system. Without resistance to flow there is no flow. As the system is open on both ends of the system all of the time to a larger or lesser degree, resistance to flow and storage are what keeps it functioning. Mass flow restrictions are differential pressures in the system, which change as a square function of flow change. It is important to design or retrofit your system for a maximum differential at highest flow, highest temperature, and lowest inlet pressure. This will produce the highest differential pressure across the components being evaluated. Although we are recommending a conservative approach towards this process,

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the piping distribution system should not be made intentionally oversized or all the same size for convenience. Oversized piping will not provide economical storage and will make it difficult for supply to see demand efficiently. A reasonable differential pressure would be 1–2 psid from the discharge of the cleanup equipment at the supply or the discharge of the demand controller, as it applies to your system, to the farthest point in the demand system at the previously discussed design conditions.

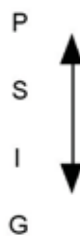
- C. In most systems that have distribution problems, you should minimize waste and flat-line transient users with dedicated storage and metered recovery at the point of use before considering making changes in the piping distribution system.

As little as a 10–20% demand reduction at the peak condition can be sufficient to eliminate most distribution losses and the requirement for piping retrofits.



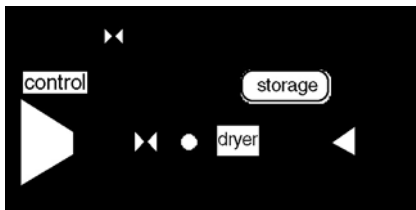
Reduce Supply Energy Wherever Possible

- A. When 100% of demand is at a lower pressure than the lowest supply pressure, set up the supply pressure to optimize the lb./kw of compressed air energy for the onboard compressors. Operate all compressors that need to be on flat out and optimized except one compressor trimming and all other compressors off regardless of inlet conditions or relative demand load. You must optimize the compressor and the motor simultaneously. Optimal means the most lbs. or scf at the optimal density (pressure and temperature), while managing the highest power factor and motor efficiency simultaneously. In this scenario, the trim compressor is the only compromise to “optimal,” assuming you can maintain a range of supply pressure across the range of load conditions that relates to optimal on the base load compressors. Another option is to trim with variable frequency drive compressors using storage continuously, while adding and subtracting base load compressors. The VFD compressor or compressors will displace or fill in the removal or addition of a base. In this case you will optimize both the base load compressors and the trim compressors at the same time.



NOTE: This is called a “Bellows Effect” operating protocol.

- B. Base compressors should always be selected based on the best energy efficiency. Trim compressors should be selected first on operating speed to cold or hot start and shutoff capabilities, and secondly on their flexibility for automation interface. If you are trimming with VFD/s, the same requirements are applicable. This typically translates into smaller, less permissive compressors. You must be certain that the total trim capacity (one, two, or three trim compressors) is equal to or larger in capacity than the largest base compressor in the supply arrangement. This will ensure that there are no gaping holes in supply, so that you can make smooth transitions from one power level to the next. Supply systems that don’t have this capability end up running too much power part loaded all of the time to support the transitions. Remember that bigger is more expensive.
- C. Develop an operating profile for the supply system, which optimizes the compressors based on a full range of usage and conditions. In most systems, the only time the system is remotely efficient is during peak load. It generally goes downhill during lighter or low loads. Also evaluate the full range of system’s usage against the full range of ambient inlet and cooling conditions to determine how the system will work before you make any final plans on equipment selection. Make every attempt to manage peaks with potential energy instead of online power. You must also evaluate the risk of a unit failure in order to have a solid curtailment plan. If brownouts or blackouts are common, you must include this in your plan.
- D. Unload all unnecessary ancillary power, such as dryers, pumps, fans, etc. through the use of more efficient controls and motor drivers. Size all filtration and dryer equipment for a total differential of 3.5–5 psid. The differential should be at the highest inlet flow, highest inlet temperature, and the lowest inlet pressure. The differential on the filtration should be in a wet and clean condition. Plan the additional differential from dirt loading when selecting the compression equipment, so that you do not overload the motor drives, because you will absorb the added differential at the air end discharge. We would recommend no more than an additional 1.5–2 psid on the total filters. There are filters available to accomplish this with a change every five to six years at this dirt-loading rate. The total differential across all cleanup equipment should not influence the total connected horsepower on the compressors by more than 4% at the worst case maintenance condition.



- E. Use a master signal for the compressors located in the dry clean storage downstream of the contaminant control equipment. If the signals are in the compressors upstream of the cleanup equipment, the compressors controls will respond to the demand interpreted through the differential pressure, which changes as a square function of flow change. This causes the compressors to overshoot and undershoot, which results in hunting. This requires excess energy to compensate.

Please note in the illustration that we have installed a 3-way valve so that you can return to local control signals when you wish to isolate the compressor from the system. It is also important to note that the adjustment of the compressor controls, with a master control signal, should be based on controlling downstream of the cleanup. If the pressure across the cleanup equipment is 10 psid, when you moved the signal, you would also want to reduce the control set points on the compressor(s) an additional 10 psid. This is because you will absorb the differential when you move the signal and without adjusting the operating set points for the compressor(s), you may overload the motor.

- F. Develop an operating profile that takes control storage, set points of the compressors, signal locations, and differentials into account. Put it down on paper prior to implementing it and check the range of conditions to make sure it will work. Don't put fudge factors into the profile. This is not an art form. It is a science. If you are not sure of what you are doing, contact a technology firm who can assist you. Literally, 95% of all compressor profiles are not set up correctly. Most engineering firms that design systems select the equipment and never think through the operating protocol or profile prior to installation.

- G. Lastly, you must get the system to operate effectively and efficiently before you automate it. More than 90% of the time, users try to apply automation to a system to get it to work properly. If you automate a system that doesn't work, you will have an automated mess. You must be able to get it to work correctly on the local controls first. When and if you automate, keep in mind that their purpose is to refine the operating cost and reliability issues across all conditions unattended. Automate the operation based on at least rate of change, storage, time, and pressure. You may even wish to add a selective rate of change protocol that chooses the correct compressor for the situation. Take your time and test your concept prior to making the decision by preparing algorithms, including transitions of power and demand and failure scenarios. Keep in mind that you do not have to match the event in the system. You only need to slow it down so you can wait longer. The essence of a masterfully designed system is the ability to control demand by matching transient events as quickly as possible with an expander or demand controller serviced with potential energy.

Once this is accomplished, the compressors' controls job is managing control storage by replenishing it as slowly as possible. The longer you can take, the less energy you will use.

SUMMARY

A compressed air system is a highly interactive configuration with all aspects affecting all other aspects. Developing an action plan to improve the efficiency and reduce the operating cost can be rewarding, but must be done in the correct order to enjoy the success and avoid production inconvenience. It is a process of black and white with a lot of gray in between. Far too many owners want to buy a solution, rather than apply one. Problem definition, metrology, and careful planning are all essential. When you have completed the action plan, don't forget to measure the results. Validation is necessary to support your return on investment strategy.

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REDUCING YOUR LEAK RATE WITHOUT REPAIRING LEAKS

BY CHRIS E. BEALS

“During our audits, we have found leak rates as high as 6,400 scfm, which exceeded 50% of the total demand.”

As plant personnel know, repairing compressed air leaks can be an expensive, labor-intensive, and never-ending process. This article discusses ways plant personnel can reduce and maintain their leak rate at a lower level without repairing leaks. It discusses how pressure/flow controllers, variable speed, and variable displacement compressors, automation, and addressing critical plant pressures enable plant personnel to lower the header pressure, which eliminates artificial demand and controls the leak rate. More importantly, the article brings a new dimension to the idea of turning off the air to idle equipment by focusing plant personnel's attention on the idle time within the cycle of operating equipment.

Reducing Your Leak Rate without Repairing Leaks

During our audits, we have found leak rates as high as 6,400 scfm, which exceeded 50% of the total demand. Rather than being an exception, we find 50% leak rates common in some industries, while in others, we have found that a more reasonable 25% leak rate can represent a demand as high as 4,500 scfm. At an energy rate of \$0.05/kWh, a leak rate of 6,400 scfm costs approximately \$568,000 or \$89/scfm annually. Taking into consideration other associated costs, such as cooling water, maintenance, etc, the annual cost approaches \$110/scfm.

At a cost of \$110/scfm, why aren't plant personnel repairing air leaks? Some of the most common reasons given are:

- ✱ We didn't know how much leaks cost
- ✱ Management hasn't made it an issue
- ✱ We need a shutdown to find leaks
- ✱ Unless a leak affects production, production won't give us time to repair it
- ✱ We don't have the manpower
- ✱ It costs more to repair the leak
- ✱ We used to repair leaks but we never saved any energy
- ✱ New leaks appear as fast as we repair them

While compressed air system auditors have been pointing out the high cost of compressed air and promoting compressed air system efficiency for more than 20 years, it wasn't

until the inception of the Compressed Air Challenge in 1998 that plant personnel could readily find training in compressed air systems. The Compressed Air Challenge offers its “Fundamental of Compressed Air Systems” and “Advanced Management of Compressed Air Systems” classes throughout the United States on a regular basis.

While conducting compressed air system audits across North America and Europe, we have found that most plant managers are interested in saving energy; however, the level of their interest in compressor air correlates directly with the cost of energy (\$0.02 to \$0.15/kWh). If the plant has a low energy rate, you may still be able to get management's attention if there's a large savings opportunity or retrofitting the compressor air system resolves a production problem.

When management decides that reducing compressor air system costs is important, we find that the most successful programs begin with an audit of both the supply and demand sides of the compressed air system, which provides management with a “road map to success.” The audit of the supply side of the system shows plant personnel how to eliminate waste, reduce pressure drop, improve air quality, and coordinate the compressors so that when demand reduces, power reduces by the appropriate amount. The audit of the demand side of the system shows plant personnel how to eliminate waste and inappropriate uses, while improving production equipment performance and plant productivity.

We find that the programs most effective at reducing and maintaining a lower leak rate are the ones that provide employees with the

equipment to find leaks during normal production hours and push the responsibility to manage and maintain the system down to lower level management and their employees. In these programs, upper management sets performance levels for compressed air usage and makes compressed air part of each manager's performance review. In addition, each manager must report on his department's air usage, as well as leaks found, tagged, and repaired on a weekly basis.

Often we find leaks on components of critical production equipment that are either expensive to repair or must be repaired during a scheduled production outage, which may only occur once a year. In these cases, it's important that plant personnel not only repair the leak, but also identify and eliminate the root cause that created the leak. In addition, we must employ every method available to reduce the leak rate until plant personnel can repair the leak.

The opportunities to reduce the leak rate without repairing leaks include:

- Turning off the air to idle equipment
- Reducing plant pressure
- Regulating end uses below the header pressure
- Shutting off the air to a pneumatic circuit on production equipment during a portion of the production cycle

Reducing the plant pressure and regulating equipment pressure below the header pressure have the added advantage of reducing the air consumption of equipment, as well as reducing the leak rate.

Turn Off the Air to Idle Equipment

In most plants, when production equipment operators shut off their equipment, the compressed air doesn't shut off so the compressors keep delivering air to support the leaks and the power company keeps collecting revenue even though the equipment

isn't producing any parts. Plant personnel can eliminate this waste by installing electrically operated solenoid valves that shut off the air to the idle equipment when the operator turns the equipment off. In order to take full advantage of the opportunity, plant personnel should wire the automatic solenoid valve into the run circuit rather than the on/off circuit; however, in doing so they must take into consideration safety and maintenance issues, equipment adjustment and setup requirements, and startup procedures. Often plant personnel can address these issues by installing time delays and a jogging button in the run circuit and a time delay in the stop circuit. When plant personnel find that they can't completely shut off the air to the equipment then we recommend splitting the pneumatic circuit into multiple circuits and shutting off as many circuits as possible. Installing automatic solenoids can be an expensive project, so we recommend installing them over an extended period in conjunction with normal maintenance schedules. When management personnel attempt to have the operator shut off the air manually, it creates a management issue and only works for a short time, if at all. Our recommendation is to "eliminate management issues by doing it automatically."

Often plant personnel abandon obsolete or idled equipment in place. When this happens, remember to turn off the air to the equipment. In addition, plant personnel should consider turning off the air to a section of the plant or a building when it's vacant.

Reducing Plant Pressure

A good "rule of thumb" to remember is that "for every psi increase or decrease in system pressure, demand changes by 1% times the percentage of unregulated demand." For example, if the plant is 100% unregulated and demand is 20,000 cfm, then if we reduce the system pressure 10 psi, demand will decrease by 2,000 cfm, without repairing any leaks.

$$\Delta \text{cfm} = (\text{TD} * ((P_1 - P_2) / 100)) * (\text{URD} / \text{TD}) \text{ Equation (1)}$$

Where,

Δcfm = change in cfm

TD = total Demand in cfm

P_1 = original operating pressure

P_2 = proposed operating pressure

URD = unregulated demand in cfm

For example,

$$20,000 \text{ cfm} \times \frac{110 \text{ psi} - 100 \text{ psi}}{100} \times \frac{20,000}{20,000} = 2,000 \text{ cfm}$$

In an uncontrolled system, if you repair leaks or reduce demand, the pressure will increase, which will subsequently increase demand. Using the same example, if plant personnel repair 2,000 scfm in leaks and the pressure increases

5 psi, then the demand will increase 900 cfm, so the total demand will be 18,900 cfm instead of the expected 18,000 cfm.

$$18,000 \text{ cfm} - (18,000 \text{ cfm} \times \frac{110 \text{ psi} - 115 \text{ psi}}{100} \times \frac{18,000}{18,000}) = 18,900 \text{ cfm}$$

This example is part of the reason why plant personnel often find leak repair unproductive. The other reason relates to the compressor controls. If the plant had several lubricated rotary screw compressors operating in modulation, repairing 2,000 cfm in leaks may only reduce power by 1.5% instead of the expected 11.4%. On the other hand, if the plant has centrifugal compressors operating in blow off or bypass, they may not even save the 1.5%. Plant personnel must coordinate the compressor controls and control the system pressure to realize the appropriate energy savings from repairing leaks.

In order to lower the system pressure, plant personnel must first identify and address the critical pressures that are driving up the system pressure. In most cases, plant personnel already know where these critical pressures are located, but they aren't sure how to address them. To identify the real cause of each critical pressure, plant personnel must develop a pressure profile of the system and use high-speed data loggers to signature map each end use associated with a critical pressure. This information ensures success and enables plant

REDUCING YOUR LEAK RATE WITHOUT REPAIRING LEAKS

personnel to select the most cost-effective way to address each critical pressure. Some of the methods used to address critical pressures include:

- Dedicated storage
- Dedicated storage with metered recovery
- Larger pipe or tubing
- Larger cylinders
- Boosters
- Dedicated compressors

In a comprehensive compressed air system audit, the auditor will include these solutions in your “roadmap to success.”

In many plants, plant personnel protect against production outages due to compressed air by operating the system at a higher pressure, which provides time to start another compressor before the pressure falls below the minimal acceptable pressure. In this case, installing additional storage will enable plant personnel to lower the system pressure.

Some other ways to maintain a lower system pressure include:

- Lowering the compressors’ set points
- Automating the compressors by either networking them together or installing a master controller with interface panels
- Installing a variable speed compressor and automating the other compressors
- Installing variable displacement compressors and networking them together
- Installing a pressure/ flow controller along with sufficient control storage

If plant personnel only lower the compressors’ set points, there may still be a significant variation in system pressure, which presents an opportunity to further reduce the leak rate without repairing leaks. Automating the compressors minimizes pressure variations by controlling the pressure within a single dead band of 4 to 12 psi. In some cases, plant personnel can reduce the upper end of this band further by installing additional storage. In addition, plant personnel must install the automation’s control pressure signal point downstream of the cleanup equipment in order to eliminate the pressure variation due to changes in flow across the cleanup equipment (dryers and filters). Except when the variable speed compressor is operating at a capacity below its minimum speed, integrating one with existing compressors reduces the system variation to about 1.5 psi, as long as the control pressure signal point is located downstream of the cleanup equipment. When the variable speed compressor operates at a capacity below its minimum speed, we typically see a system pressure variation of 7 psi, which increases with insufficient storage. Installing a pressure/ flow controller with sufficient storage has none of these issues and controls the system pressure within 1.5 psi. We can maximize the energy savings in a system containing a pressure/flow controller by operating most of the compressors downstream of the pressure/flow controller. The pressure variation with a pressure/ flow controller increases to 3 psi whenever the automation unloads a downstream compressor. The best system we have seen to date, at minimizing pressure variation contains four, 1,500 cfm, lubricated, variable displacement compressors networked together with PowerSync controllers. This system, which has a large amount of storage, as well as the control pressure signal point located downstream of the cleanup equipment, controls the system pressure within 1 psi, even when the compressors are starting and stopping. For most plants, the problem with this arrangement is that it requires a significant capital investment in new compressors.

Making a choice between these options depends somewhat on whether it’s a new installation or a retrofit of an existing one, but more so, on the system capacitance, the benefits of a more accurate header pressure, the amount of unregulated demand, compressor performance, and return on investment, capital costs, and other management priorities. The auditor must take all of these items into consideration when he or she prepares your “roadmap to success.”

Regulating end uses below the header pressure

Equipment manufacturers prefer that their equipment operate below the header pressure so that its components operate off a constant pressure set by their regulators. Operating the equipment below the header pressure also reduces air consumption by reducing the pressure upstream of orifice type devices and decreasing the compression ratio, which partly determines how much air a cylinder consumes.

Plant personnel often find regulators set at a higher pressure than necessary or wide open. The reasons operators most often give for adjusting regulators are “it won’t work,” “it moves too slowly,” or “we needed a higher pressure to increase cycle times.” Upon analysis, we find that one of the following: a large air leak, insufficient storage downstream of the regulator, undersized tubing and/or control valve, or the control valve located too far from the article it’s controlling. Resolving these issues will enable plant personnel to reduce the pressure, which

will reduce the leak rate without repairing the leaks. This is especially important with the rampant use of plastic tubing and pushloc fittings. Some years ago, an independent study determined that 37% of pushloc fittings leak upon startup, so in an effort to eliminate a root cause of leaks, we recommend that plant personnel replace the pushloc fittings with a double back ferrule design that accommodates the plastic tubing. When a cylinder moves as fast as 0.04 seconds, the regulator prevents access to upstream storage and results in a large pressure drop in the tubing between the regulator and the control valve. This is why cylinder manufacturers sell empty cylinders to mount at the inlet of the control valve. On the other hand, plant personnel can first try installing larger tubing between the regulator and the control valve and moving the control valve closer to the cylinder. These modifications enable operators to lower the pressure, reducing the leak rate without repairing leaks. In addition, these modifications have the added advantage of reducing the air consumption of cylinders and other components. Finally, we often find the reduction in air consumption that occurs after retrofitting the pneumatic circuits on the plant's production equipment and reducing their regulator settings exceeds the demand reduction achieved by lowering the system pressure.

Shutting Off the Air to a Pneumatic Circuit on Production Equipment During a Portion of the Production Cycle

When the opportunity exists, we often find that shutting off the air to a pneumatic circuit on production equipment during a portion of the production cycle offers the largest opportunity to reduce the leak rate, without repairing leaks. For example, in one plant with a couple

hundred of identical production machines, we measured the leak rate at 2,750 scfm. Most of the leaks were due to scored cylinder rods and damaged rod packing. Plant personnel estimated the cost to repair the 900 cylinders at \$1,100,000, while it cost \$195,440 annually to support the leaks. On this basis, the simple payback was 5.63 years if plant personnel could maintain a zero leak rate. Based on a more realistic leak rate of 1,000 scfm, the simple payback was 8.85 years. Neither of these simple payback rates was acceptable. Working with plant personnel, we found that the cylinders only operated for 3 minutes out of a 13-minute cycle, which meant they sat idle 76.9% of the time. We decided to divide the pneumatic circuit on each machine into two circuits, install an automatic solenoid valve, and program the PLC to shut the air off to the cylinders when it wasn't required. This project cost \$109,000 to implement, reduced the leak rate by 2,100 scfm, and saved \$149,200 annually. This project had an acceptable 8.8-month payback. In addition, plant personnel are in the process of eliminating the root cause of these leaks by modifying the cylinders to accept a different, more durable type of packing.

In another plant, we found a production machine with five positions of which only one position operated at any one time. In this case, we decided to install an automatic solenoid valve at each position, and program the PLC to shut the air off to the position when it wasn't operating. This reduced the leak rate by approximately 1,100 scfm from 1,500 scfm to 400 scfm.

For more information contact Chris Beals, Senior Auditor, Datacation, Phone (303) 771-4839, email: cbeals@earthlink.net

Compressed Air Best Practices

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SIX POTENTIALLY INAPPROPRIATE USES FOR COMPRESSED AIR

BY HANK VAN ORMER

Compressed air is often overlooked in energy studies because many people do not fully understand compressed air equipment, the air system, or what it costs to produce compressed air power. For those willing to look and use some good old common sense, it is a land of opportunity.

Just how expensive is compressed air? It takes about **8 HP** of electrical energy to produce **1 HP** worth of work with compressed air. Do you think your electric power is expensive? Your air power is **8 times more!**

Every process in your plant, which has a need for compressed air, has a minimum supply in CFM (flow) and PSIG (pressure required) at the process to run at optimum level. When you supply air at a higher pressure and consequently more volume, you create extra expense, but with **NO INCREASE IN PRODUCTIVITY OR QUALITY**. It is estimated that 50% of the air produced in industrial plants is not used for production!

This is often termed “Artificial Demand” or “System Overdrive.” Do you know the lowest effective pressure and/or flow requirement at each process? Do you measure and monitor to stay on target? Do you use and/or supply too much? You cannot manage the use and cost if you do not measure and monitor.

Artificial demand can be created by inappropriate uses of compressed air. Potentially inappropriate uses of compressed air are demand-side applications that *may be* more efficiently handled by another power source rather than compressed air. In this article, we will examine areas that represent potentially inappropriate uses of compressed air. They are cabinet cooling, blow-off air, air-operated vacuum generators, air-operated diaphragm pumps, air motors and hoists, and air vibrators.

1. Cabinet Cooling

Cabinet cooling is often required to obtain reasonable life and performance of the electronic equipment in control cabinets. There are various means of accomplishing this. Blowing straight compressed air into the cabinet is generally not an efficient or cost-effective use of a compressed air system. Vortex tube coolers, refrigeration units, heat tubes, heat pipe, and thermoelectric refrigeration are some other options to consider.

Six Potentially Inappropriate Uses

1. Cabinet Cooling

2. Blow-Off Air

3. Air-Operated Vacuum Generators

4. Air-Operated Diaphragm Pumps

5. Air Motors and Hoists

6. Air Vibrators

Vortex tube coolers deliver chilled air with no moving parts, and therefore, may use less compressed air. Vortex coolers should always be:

- Regulated to the lower effective pressure
- Equipped with a flow generator set to the lowest effective flow
- Equipped with automatic temperature controlled shutoffs
- Run in to a vented cabinet

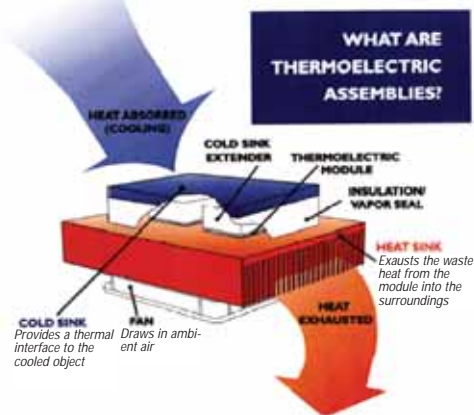
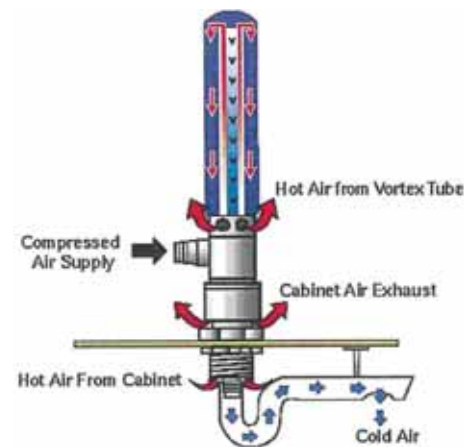
Refrigeration units should be carefully selected and equipped with automatic regulation control.

Heat tubes or heat pipe cores are made from highly conductive alloy materials for fluid cooling. In operation, the heat flows from the outside by means of a fluid phase change. As heat is applied to the core (inside the cabinet), the fluid inside the pipe absorbs heat, is vaporized, and then travels to the condenser end (outside the cabinet), where it is cooled back to a liquid. The liquid returns to the evaporator inside the cabinet, etc. An exterior fan usually draws heat away from the core, which cools the internal cabinet without exposing the interior of the cabinet to ambient air. Open blow, refrigeration, and vortex tube cooling may all be replaced with “heat tube” cabinet coolers with a potential savings of 3.5 to 4 kW each on a 30" x 24" x 12" average cabinet. The initial cost is usually in the \$700 to \$750 range with a potential resultant power savings of \$1,000 – \$2,000/year each.

Thermoelectric refrigeration, utilizing the Peltier effect, can effectively cool to 1500 Btu/HR with very little electricity.

Thermoelectric modules are solid-state heat pumps that operate on the Peltier effect. A thermoelectric module consists of an array of p- and n-type semiconductor elements heavily doped with electrical carriers. The array of elements is soldered so that it is electrically connected in series and thermally connected in parallel. This array is then affixed to two ceramic substrates, one on each side of the elements. Let us examine how the heat transfer occurs as electrons flow through one pair of n- and p-type elements (often referred to as a “couple”) within the thermoelectric module:

Electrons can travel freely in the copper conductors but not so freely in the semiconductor. As the electrons leave the copper and enter the hot side of the p-type, they must fill a “hole” in order to move through the p-type. When the electrons fill a hole, they drop down to a lower energy level and release heat in the process. Essentially the holes in the p-type are moving from the cold side to the hot side. Then, as the electrons move from the p-type into the copper conductor on the cold side, the electrons are bumped back to a higher energy level and absorb heat in the process. Next, the electrons move freely through the copper until they reach the cold side of the n-type semiconductor. When the electrons move into the n-type, they must bump up an energy level in order to move through the semiconductor. Heat is absorbed when this occurs. Finally, when the electrons leave the hot side of the n-type, they can move freely in the copper. They drop down to a lower energy level and release heat in the process.



SIX POTENTIAL INAPPROPRIATE USES FOR COMPRESSED AIR

In summary, heat is always absorbed at the cold side of the n- and p-type elements. The electrical charge carriers (holes in the p-type; electrons in the n-type) always travel from the cold side to the hot side, and heat is always released at the hot side of thermoelectric element. The heat-pumping capacity of a module is proportional to the current and is dependent on the element geometry, number of couples, and material properties.

Comparison of various types of control cabinet cooling

Based on 1500 Btu/HR auxiliary cooling (metal cabinet 4' wide x 1' deep x 4' high (135° F maximum temperature)

	COMPRESSED AIR BLOW OPEN	AMBIENT AIR FAN	REFRIG- ERATION	VORTEX TUBE	HEAT PIPE	THERMOELECTRIC REFRIGERATION
INITIAL COST	\$20	\$200	\$700	\$525	\$850	\$1,800
INSTALLATION	\$20	\$150	\$200	\$200	\$200	\$200
ANNUAL MAINTENANCE	\$0	\$20	\$150	\$20	\$50	\$20
ANNUAL ELECTRIC OPERATING COST	\$23,536	\$331.77	\$306.00	\$1,664*	\$35.42	\$122.64
LIFE EXPECTANCY	Infinite	5 Years	2.3 Years	Infinite	Infinite	20 Years
LIMITS	Will not work above 90° F	Will not work above 70° F	May not work at 135° F	Can work up to 200° F	Will not work above 90° F unless water cooled	Will work up to 140° F 1500 Btu/HR maximum cooling available today

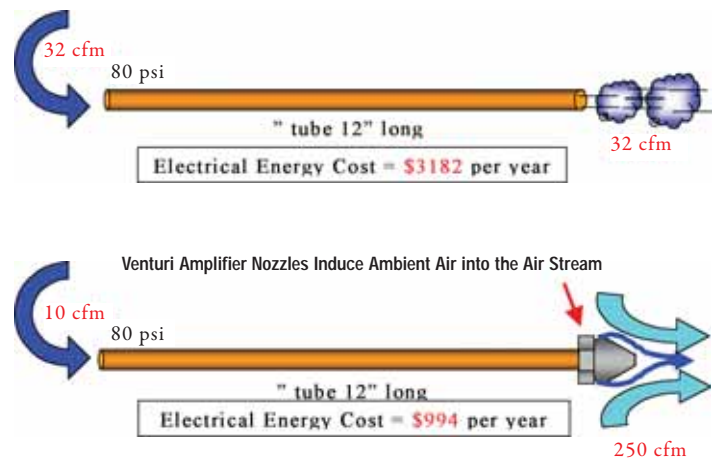
*Most Vortex tubes, properly installed with temperature controls, will operate at half of this cost (\$832/yr.) or less.

2. Blow-Off Air

Regardless of application, there are several guidelines that should always be applied to compressed air being used for open blow-off:

- Use compressed air when nothing else will do — for example, mechanical, etc.
- Use high pressure only as a last resort — low pressure air from a blower will lower cost
- All blow-off air should be regulated to the lowest effective pressure — higher pressure means higher flow, which may not be needed
- Use Venturi air amplifier nozzles or air inducers whenever and wherever possible — this will usually reduce blow-off air at least 50%, freeing up more air flow for other applications
- All blow-off air should be shut off (automatically) when not needed for production
- ¼" lines running as blow off on units will use approximately 32 cfm each at 80 psig

An alternative is to use air amplifiers, which require less compressed air. Air amplifiers use “Venturi” action to pull in significant amounts of ambient air and mix it directly into the air stream, which amplifies the amount of air available at the point of use. Air amplifiers have amplification ratios up to 25:1. Using 10 cfm of compressed air can supply up to 250 cfm of blow off air to the process and generate a savings of a 15 cfm compressed air per ¼" blow off.



3. Air-Operated Vacuum Generators

In order to create a vacuum, some kind of air pump or vacuum pump is required to evacuate the volume. There are two basic approaches to accomplish this task: mechanical pumps and vacuum generators (or ejector pumps).

Mechanical Pumps

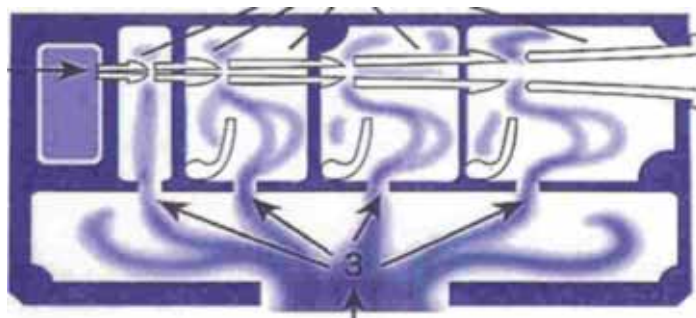
Mechanical pumps usually have an electric motor as a power source for industrial applications. The “design” resembles compressors — both in lubricated and nonlubricated types. There are two basic types of mechanical pumps:

1. Blowers (e.g., regenerative and centrifugal) — suitable for larger volumes and low maximum vacuum requirements. These units are slower to start up and run down.
2. Positive displacement (e.g., vane, piston, and screw) — suitable for high vacuum and flow requirements.

High-efficiency mechanical pumps are used in centralized vacuum systems, and usually require “higher volume” capabilities. Use of positive displacement pumps is most effective where the user requires a continuing large volume flow at a sustained high maximum vacuum. With requirements beyond an average of 14 inches of mercury vacuum, the input kW to the pump will be reduced as the vacuum increases due to the lower mass flow of air being handled.

Vacuum Generators (or Ejector Pumps)

Vacuum generators are often selected for more localized or “point of use” vacuum applications, due to the smaller volumes they handle and their faster local response times. Manufacturers of production machinery often supply them as standard equipment.

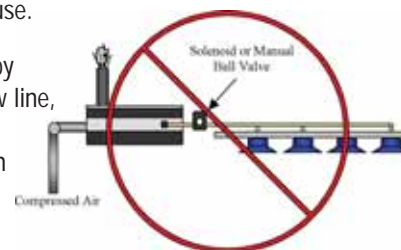


There are several basic types of ejector pumps: **single-stage**, **multi-stage vacuum generators**, and **coaxial vacuum generators**.

Misapplication of the type of generator can create significant wasted energy. Always have these applied and selected by knowledgeable personnel if they are to be used.

Regardless of the type of vacuum generator used, all installations should:

- Regulate feed air at the lowest effective pressure
- Run with the shortest possible “time-on” vacuum in the cycle.
- Shut off when not in use.
- Shut off the vacuum by shutting off the airflow line, **NOT** the vacuum line. We see this more than 50% of the time.



When well-controlled Venturi vacuum generators are often more productive (cycle time) and equal to or more efficient than a large central system.

SIX POTENTIAL INAPPROPRIATE USES FOR COMPRESSED AIR

4. Air-Operated Diaphragm Pumps

Although air-operated diaphragm pumps are not very energy efficient, they tolerate aggressive conditions relatively well and run without catastrophic damage even if the pump is dry. There are several questions to ask and areas to investigate that may yield significant air savings:

- Is an air-operated diaphragm pumping the right answers? An electric pump is significantly more energy efficient. Electric motor-driven diaphragm pumps are readily available. An electric motor-driven progressive cavity pump may also well work.
- Consider installing electronic or ultrasonic controls to shut the pumps off automatically when they are not needed. Remember that pumps waste the most air when they are pumping nothing.
- Is the pump running most of the time at the lowest possible pressure? The higher the pressure is, the more air is used.

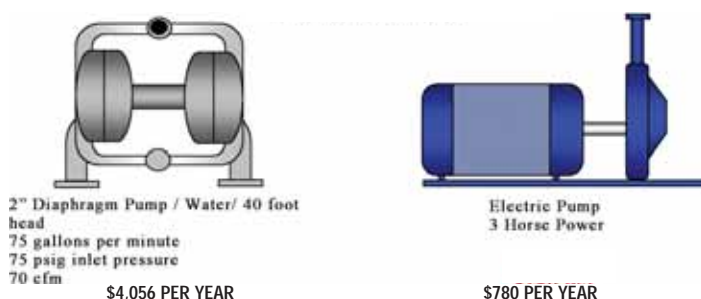
For example: Filter packing operations often do not need high pressure except during the final stages of the filter packing cycle.

- Controls can be arranged to generate lower pressures in the early stages and higher pressures later on, which may generate significant savings.
- Is the cycle time controlled to the lowest effective speed? There are electronic systems today capable of optimizing the cycles, reducing the air flow up to 50%, and keeping the product throughput equal or larger.

Generally, when the volume is high and the head pressure is low, operating over significant hours, an electric-operated pump will be an effective choice.

For example: A 2" air operated diaphragm pump, pumping water at 130 gpm will use 25HP worth of compressed air (\$9,947/yr.). An electric pump may well do this for 5HP (\$1,989/yr.)

AIR OPERATED DIAPHRAGM PUMP COMPARED TO ELECTRIC DIAPHRAGM PUMP



5. Air Motors and Hoists

Air hoists are rated in tonnage of capacity. Often the air motor horsepower is the same for several different tonnage ratings. Care should be taken to review the actual performance chart of the hoist in question. There is no question that an electric operated hoist will use a great deal less total input power than the compressed air type.

The same level of savings associated with air hoists can be achieved for a compressed air motor in general industrial use. These applications use 25 to 30 cfm of compressed air (6 to 8HP) per HP rating.

The most effective payback opportunities exist when the operating cycle in hours is high. There are other considerations, both ways; air hoists with occasional use have a high incidence of unnoticed air leaks. Misapplication of a hoist, causing short life, is almost impossible with an air hoist, but frequent with an electric. Safety issues are always there.

The following data from one manufacturer clearly shows the difference.

HOIST PERFORMANCE

ELECTRIC	PNEUMATIC
1.5 HP Brake Motor TEC	4.25 HP Air Motor and Brake
115/220/1/60	110 cfm @ 65 psig
5600 lbs. Bare Drum Pull	5,000 lbs. Base Drum Pull
NEMA 4 Electrical Enclosure	N/A
Remote Control	Remote Control
Average Price — \$3,000 each	Average Price — \$3,500 each
	110 cfm @ 100 psig System Press
	HP required to produce 110 cfm @ 100 psig (reduced to 65 psig)
	$28 \text{ hp} \times 0.746 \div 0.93 = 22.5 \text{ kW}$
$1.5 \text{ kW} \times 0.05 \times 1 = \$0.075/\text{hr}$	$22.5 \text{ kW} \times 0.05 \times 1 = \$1.125/\text{hr}$

PER HOUR ELECTRICAL ENERGY COST

\$0.075 \$1.125

NET ELECTRICAL ENERGY OPERATING COST

1000 hrs/yr =	\$75/yr	\$1125/yr
2000 hrs/yr =	\$150 /yr	\$2250/yr
4000 hrs/yr =	\$300/yr	\$4500/yr
6000 hrs/yr =	\$450/yr	\$6650/yr

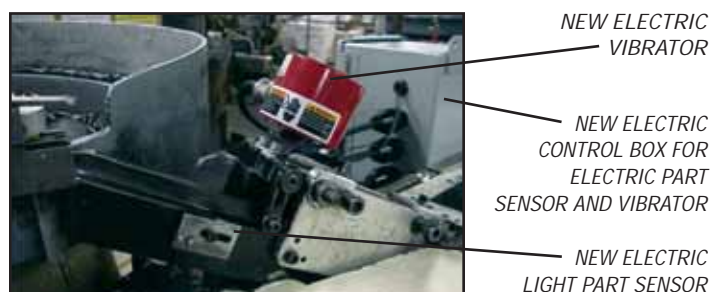
6. Air Vibrators

Air vibrators are used to keep product or packaging moving or separated — for example, keeping lids separated prior to sealing. If a plant employs air vibrators that use about 10 cfm each, they will require about 2.5 HP or more to produce the same as a similar electric vibrator might use at about 0.25-HP input energy.

AIR VIBRATOR COMPARED TO ELECTRIC VIBRATOR



NOTES: AIR SENSOR SYSTEM AND AIR VIBRATOR ON ALL THE TIME



NOTES: NEW TOTALLY ELECTRIC SYSTEM ONLY TURNS ON WHEN PARTS ARE NEEDED FOR THE MACHINE

Hank Van Ormer is a leading compressed air systems consultant and has implemented over 1200 air improvement projects. Contact at (740) 862-4112 and www.airpowerusainc.com.

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NPE

NPE 2006 attracted a total of 64,451 registrations and set new records for international participation. While this total registration figure was 2% greater than at NPE 2003, the number of visitor registrations (as distinct from exhibitor registrations) was a full 9% greater than three years ago. Greater still was the increase in international registrations: After subtracting exhibitor registrations, the total of international visitor registrations was 33% larger than in 2003 and accounted for 24% of all visitor registrations for NPE 2006.

shows. International exhibitors (companies coming directly from outside the U.S., as distinct from U.S. subsidiaries) accounted for 33% of the total, compared with 30% in 2003 and 24.5% in 2000.

“While the unprecedented participation by international exhibitors and visitors certainly contributed to the high level of excitement at NPE 2006, it was only one of the factors causing this show to mark a turning point in NPE history,” said Walt Bishop. “In preparing for NPE 2006, SPI developed innovative programs that would broaden the technological content of the show, attract new kinds of participants, and increase the value of attending. We will further develop this strategy of tradeshow transformation as we begin to prepare for NPE 2009.”

The TPE / Rubber, North American Moldmakers, and New Technology pavilions (all NPE “firsts”) attracted about 40 exhibitors that had never before participated in an NPE. At these pavilions (and elsewhere in the show), many first-time exhibitors focused on technologies that are just emerging or had previously played only a small role at NPE, such as nanocomposites, bioplastics, degradable plastics, thermoset rubber, and RFID. In addition, a redesigned and much-expanded international marketing program by SPI brought many first-time international exhibitors to the show, including nearly all exhibitors from China. In total, the number of companies at NPE 2006 making their NPE debut was 700, or 38% of the total, compared with only 18% for NPE 2003.



Banners overhead in the Grand Concourse of McCormick Place announce the NPE 2006 show and its sponsor, SPI.

A total of 1,850 companies exhibited at NPE 2006, taking 949,500 sq.ft. (88,210 sq.m.) of net exhibit space. The number of exhibitors was 4% fewer than in 2003, reflecting industry consolidation, according to Walt Bishop, SPI vice president of trade

2006

Compressed Air Was Everywhere

The compressed air industry was strongly represented at NPE 2006 and there were some interesting compressed air dryers on display by plastics equipment suppliers. Displaying high-pressure compressors were Ingersoll Rand, Bauer, Ateliers Francois, and Gardner Denver-Bellis & Morcom. Exhibiting air compressors and boosters were Kaeser Compressors and Atlas Copco. Showing water chillers and high-volume cycling air dryers was Motivaire. Vaisala displayed hand-held dew point meters.

There were a number of suppliers of resin drying, blending, and pneumatic conveying systems to plastic processors — who also displayed compressed air dryers. The products are used for the drying of thermoplastic pellets and regrind, before processing, in order to remove moisture from the pellets both inside and out. One such company was Novatec Inc., who has developed a patented compressed air dryer called the NovaDrier™. Developed by compressed air industry veteran, Mark Haynie, the NovaDrier™ integrates coalescing filters and a membrane air dryer into a plastics resin drying package. This innovative package offers plastics processors immediate start-up, reduced maintenance, and simplified controls. The Novatec product is capable of drying between 0.5 to 225 lbs/hr. of resin. Colortronics Inc. also offered a compact compressed air drier, the CCD10, which is sold machine-mounted on to the thermoplastic pellet hopper. The total Colortronics package has heating capacities to 400 F and can offer a -40 F dew point with the optional membrane dryer. For more information visit www.novatec.com and www.colortronicna.com.

China Accounts for Largest Number of International Exhibitors

International participants played a greater role at NPE 2006 than at any previous NPE. Among international exhibitors, more came from mainland China and Hong Kong than from any other country: 127 in all, compared with only 27 at NPE 2003. Asian companies in general accounted for 45% of international exhibitors. After China, the leading countries in terms of number of exhibitors were Canada (118), Germany (62), and Taiwan (61). In all, 34 countries were represented at NPE 2006.

Visit www.npe.org to learn about the show. The next edition of the triennial show will be NPE 2009, on June 22-26.

Founded in 1937, THE SOCIETY OF THE PLASTICS INDUSTRY, INC., (SPI) is the trade association representing one of the largest manufacturing industries in the United States. SPI's members represent the entire plastics industry supply chain, including processors, machinery and equipment manufacturers and raw materials suppliers. The U.S. plastics industry employs 1.3 million workers and provides nearly \$345 billion in annual shipments. For more information, visit SPI on the Web at www.plasticsindustry.org.



Novatec Compressed Air NovaDrier™



NPE 2006 saw record attendance levels



Blown film bubble as it leaves the die in a three-layer coextrusion system operating at the Windmoeller & Hoelscher exhibit during NPE 2006.



Visitors examining an injection molding cell in the Husky booth during NPE 2006.

ALUP



ALUP Headquarters in Germany

ALUP history

ALUP was founded in 1923 near Stuttgart Germany, originally making small piston-type compressors for the rapidly growing automobile industry centered in the Stuttgart area. The name ALUP is an acronym for Auto (as in automobile), Luft (the German word for air) and Pumpen (German for pump). Stuttgart has often been called the Detroit of Europe because there are many automobile manufacturers in that area. These original compressors were used by the automobile manufacturers to put air in tires, spray paint, and run air tools.

ALUP got its start supplying air compressors to industry and is still focused on the industrial sector. Over the years, ALUP has earned a well-respected name in the European market. ALUP launched its rotary screw product line in 1980 and constantly innovates to satisfy the needs of the market. Most compressed air historians would agree that, over the last 25 years, the vast majority of all innovation in rotary screw airend, package, and control design has come from Europe. ALUP is consistently at the forefront of much of this innovation.

Energy efficiency, integrated air treatment, and spin on air/oil separation have been part of our culture for many, many years. Among the first manufacturers in the world to proactively design variable speed compressors, ALUP has always been committed to the traditional German values of innovative design, precision manufacturing, and solid support before and after the sale.

ALUP becomes part of the ABAC Group

In January of 2000, ALUP became a part of the ABAC Group. The ABAC Group is based in Torino, Italy and is the world's largest volume producer of air compressors. The ABAC Group manufactures more than 5,200 air compressors per day on 3 different continents and actively does business in 125 countries around the globe. Prior to becoming a part of the ABAC Group, ALUP was a strong European brand, but it had not expanded to other parts of the world. ABAC saw tremendous opportunity to grow ALUP into a successful worldwide brand and ALUP has flourished as a result of that strategy. With the resources of the ABAC Group and the leadership of Wilfried Koltes, managing director, ALUP has become a successful global player in the industrial air compressor business and earned the position of the industrial brand for the ABAC Group.

ABAC has deep roots in North America

ABAC American IMC, headquartered in Rock Hill, SC, celebrates its 25th anniversary this year and has shown consistent growth every year. ABAC American IMC employs 73 people in 75,000 square feet in Rock Hill, where it manufactures, distributes, and supports reciprocating and rotary screw compressors for the automotive, industrial and OEM markets in North America. "With the availability of ALUP's broad product line to complement our existing lineup of rotary and reciprocating compressors, we were excited to bring ALUP to North America," comments Rob Little, President.



President Rob Little and Vice President Tom Milton

ALUP enters the North American Market

ALUP was officially launched in the North American market at the end of 2002. The market was very receptive to the ALUP product offering.

ALUP sells exclusively through distributors. "We have a great product line, a substantial inventory of machines, parts, and components and a strong commitment to exceed the expectations of our distributors. That has been the foundation of our success and our distributors find that very refreshing," says Tom Milton, Vice President of Sales.

The product line

The North American product line consists of fixed and variable speed compressors 7.5 to 300 HP. Most models are available with integrated air treatment.

In recent years, there have been three noticeable shifts in the market, the first being a shift towards full-featured machines. Traditional American rotary screw compressors were offered as a "bare" machine and then a user could choose the options they wanted. This a la carte system enabled the American compressor manufacturers to add features to match the specifications offered by the European style machines, but, in most cases, the machines were simply not competitive and were obviously not designed to be full-featured units. ALUP estimates that two-thirds of all lubricated rotary screw compressors sold in North America have at least a low sound enclosure. Many of them have wye delta starting, TEFC motor, electronic controls, and integrated air treatment.

ALUP Rotary Screw Compressors



ALUP

Company Profile

The second shift in the market is the rapid growth in demand of small rotary screw compressors. Sixty percent of all lubricated rotary screw compressors sold in 2005 were 30 HP and under. The North American market is becoming more like the European market where compressors are often placed in smaller spaces near workers where noise is of concern. Recognizing the need in the mid 1990s, ABAC was the first to develop the complete air system, originally marketed as the Genesis. In North America, ALUP offers the second generation of this proven concept, the Combi II, a complete air system that has many benefits for the end user, including a tank mounted rotary screw compressor and complete air treatment in a compact, quiet package. All components are engineered, assembled, and tested by a single vendor and are arranged in an easily serviceable package. The Combi II compressors are available 7.5 through 30 HP and are available for immediate shipment from Rock Hill. In addition, ALUP also offers small machines in its SCK and SOLO line of variable speed compressors.



ALUP Booth at Hanover Fair

The third shift in the market is the growth in popularity of variable speed drive compressors. As much as 85% of the total cost of ownership of an industrial air compressor is electricity. The majority of rotary screw compressors in use today are running partly loaded and therefore inefficiently. ALUP began manufacturing variable speed drive compressors in the late 1990s and was among the first manufacturers in the world to do so. Designing its variable speed machines from the ground up, ALUP modified its airend profiles to be more efficient over a wider range of speed, looked at available motor technologies, and selected variable frequency motors to maintain optimum efficiency and power factor throughout the entire speed range. ALUP offers the most complete range of lubricated variable speed drive compressors on the world market from 7.5 to 300 HP.

The SOLO series of variable speed drive compressors is small, quiet, efficient, and reliable. For example, a 15 HP SOLO has a footprint of less than 6 square feet and a noise level of 64 dBA at full load. "Our broad product line and knowledge base enables us to recommend a number of different ways to increase reliability and energy efficiency within an air system. We are proud to be a leader in variable speed," says Tom Milton.

ALUP commits significant resources to research and development within its key business units to stay abreast of the latest innovations in technology and provides a viable stream of new products for the future. Rob Little says, "We are poised with an excellent product range, a growing market and a bright future."

VITAL STATISTICS

Employees worldwide: 1,400

Privately held

Worldwide product lines — Rotary screw compressors, reciprocating compressors, air treatment equipment, centrifugal compressors, blowers, booster compressors

North American product lines — Rotary screw compressors, reciprocating compressors, air treatment equipment, booster compressors

5,200 Air Compressors manufactured per day

10,000+ rotary screw compressors manufactured per year

U.S. Corporate Headquarters

1623 Cedar Line Drive

Rock Hill, SC 29730

800-528-5192 phone

803-980-5751 fax

For more information, please contact Tom Milton at 800-528-5192 extension 232, or email info@alupcompressors.com

COMPANY PROFILE

SERVICING THE CUSTOMER



Interview with Allen King, (President) and Mike Gembala (Vice President) of Blake & Pendleton, Inc.

COMPRESSED AIR BEST PRACTICES: Congratulations on your recent 35-year anniversary in business! When and how was Blake & Pendleton started?

BLAKE & PENDLETON, INC.: The Company was founded, in 1971, with a focus on supplying equipment to the pulp and paper and kaolin mining industries in Middle Georgia. Gerald L. Peterson and J. Allen King joined the company in 1973 and 1976, respectively, and acquired Blake & Pendleton from its founders, in 1980.

What is the scope of Blake & Pendleton today?

We employ more than 65 professionals located in Georgia, southeast Tennessee, and north Florida. We have six locations with full sales, service, and warehouses (Atlanta, GA; Macon, GA; Jacksonville, FL; Savannah, GA; Gainesville, FL; Dalton, GA).

Technologies we supply to industry fall into three major product categories: compressed air, pumping, and heat transfer equipment. For the compressed air segment, we offer comprehensive sales, service, and repair and fabrication capabilities. We sell new and used equipment and have a full in-stock rental line-up of electric air compressors along with rental-ready refrigerated and desiccant air dryers.

Our air end shop rebuilds rotary screw air ends for all brands. Our repair facilities also rebuild complete machine packages for all brands. This includes (among other required repairs) air end rebuild, new controls and tubing, motor rewinds, cooler cleaning, painting, and test running.

“Our air end shop rebuilds rotary screw air ends for all brands.”



Air End Rebuilding

BLAKE & PENDLETON, INC.

Company Profile



Sullair Rotary Screw Compressors

What brands of compressed air products does Blake & Pendleton represent?

We sell Sullair rotary screw air compressors and air treatment equipment. Cooper Compression is our supplier of centrifugal air compressors. SPX Dehydration & Process Filtration (Deltech, Hankison, PPC brands) supplies us with compressed air dryers and filters. For lower pressures, below 52 psig, we represent Aerzen air compressors and blowers. Curtis Toledo is our supplier of reciprocating compressors. Squire Cogswell provides medical air and vacuum systems. BEKO condensate management systems and Transair compressed air piping systems round out our complete compressed air systems lineup.

What are the major industries Blake & Pendleton serves?

All types of industries. There is no segment we don't serve. Our market area is very diversified industrially. In our market area, the historic industries are pulp and paper, mining, and textile. Thirty years ago, these industries were booming and represented a significant part of our customer base. While they are still important, the geographies we work in have seen a tremendous amount of diversification. This has been very healthy for our company and for our region. Today we see a widely diversified industrial customer base, which includes food and beverage, power plants, military installations, and electronics. Georgia has also attracted a lot of Japanese companies like YKK, Sony, and Yamaha.

So what has made Blake & Pendleton such a successful and long-lasting company?

Our focus on customer service. It's easy to say and hard to do. We bend over backwards for our customers and have built a reputation in more than 35 years of doing just that. We have an excellent reputation for doing the right thing for the customer. Sometimes you have to go beyond the call of duty. We focus our people, products, and strategy towards maintaining satisfied customers. Over time, this reputation has become well known among manufacturers in our region and has permitted us to continue growing.

What are the biggest changes you've seen in industry and in compressed air systems over these past 35 years?

The biggest changes involve the aging of the installed base of rotary screw compressors and the advent of engineered compressed air system designs in manufacturing facilities. Blake & Pendleton, together with our suppliers, has changed to meet the needs of our customers.



A Reputation For Customer Service

Compressed air systems transitioned from large reciprocating to rotary screw air compressors and centrifugals in the late 1970s to early 1980s. There is now a significant population of rotary screw air compressors, which are turning 30–35 years old. Blake & Pendleton offers our customers the option to refurbish the air compressor, no matter what make or model it is. We can take any brand of air compressor and replace whatever is required (motor, air end, coolers, controls, tubing) and make the product like new. The company also refurbishes refrigerated and desiccant air dryers. This is a convenience to our customers who don't have capital budgets for new equipment but do have funds budgeted for repairs.

When the old reciprocating compressors were being replaced by the new technology of rotary screw air compressors, there was not a lot of system engineering. The emphasis was on durability and reliability. New equipment meeting these criteria simply replaced old equipment. Over time, an engineered approach towards designing air systems has become accepted and valued by our customers. They are interested in learning how to reduce energy costs while maintaining reliability. This trend towards providing engineering value, rather than just equipment, is continuing to evolve strongly.

What are the biggest changes as it relates to the energy efficient use of compressed air systems in industry?

Technology has changed dramatically for the better. Sullair Corporation has been a leader with the highly efficient rotary screw designs introducing, for example, two-stage rotary screws in the mid 1980s. Cooper's three-stage centrifugals are also very efficient. Evolutions of variable speed drives and variable capacity air ends are now providing more opportunities. The manufacturers of all air system products (air compressors, refrigerated and desiccant dryers, filters, condensate management) have done a great job in making their equipment more efficient than they were 10 years ago.

Everyone is talking about variable speed drives. When should a factory use a VSD as opposed to a direct-drive air compressor?

When demand for compressed air, in a facility, fluctuates significantly. That is the simple way to know if you have an opportunity to reduce energy costs. Look at the air demand in all the shifts at the factory. Air demand might be stable during the first shift but fluctuate during the second and third shifts.

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BLAKE & PENDLETON, INC.

Company Profile



Helping Customers Understand Their Air Demand

There are many ways to address fluctuation demand. Variable speed is one option that is very popular today. Other options such as variable capacity compressors, flow controllers, and storage tanks should also be evaluated. This is an example of engineering a compressed air system after a good evaluation is done.

How about air audits? When are they appropriate and how should they be done?

Understanding energy costs, associated with compressed air, is now the top priority for our customers when selecting an air compressor. Most end users simply do not know what is happening with their compressed air system. Blake & Pendleton does air audits every day to help our customers understand:

- How is air used and why
- How much is used
- When is it used
- How is the system operating and at what cost

We do data logging for small and large customers to help them measure and understand the answers to these questions. Only then do we make engineered recommendations for their facility.

Air auditing has been good for Blake & Pendleton and for our customers. It has eliminated companies simply trying to sell equipment and it has allowed sales and service companies, who have invested in the capability of providing engineering value, to prosper.

Are PLC control/automation products a big part of the future?

Yes, the controls on air compressors are getting more and more sophisticated. They can now communicate with plant-wide information systems and can also offer Internet remote monitoring and control of equipment.

Sullair provides new technology controllers, now as standard features, which enable multiple machines to communicate and run in sequence. This helps our customers even out the hours-run of the air compressors while maintaining the most energy-efficient sequencing strategy required to meet plant air demand.

What do you recommend to end users with regard to their compressed air systems?

To strive to accomplish the most efficient system possible. Focus on pressure drop, control schemes, drying equipment (minimize purge air and kW input), and condensate management products. There are “Best Practice” solutions at every point. Sullair’s AirMetrix™ total system approach, addresses all aspects of a system’s performance. AirMetrix™ includes Sullair’s energy-efficient core products, air audits, system controls, system monitoring, downstream products, Airtility™ (i.e., “air-over-the-fence”), and parts and service.

How can compressed air machinery manufacturers and distributors work together to better meet the needs of industry?

Manufacturers must continue manufacturing and developing reliable and efficient products. Distributors must then ensure that the machines are used and maintained as they were intended. Distributors must either train the end user or be contracted to monitor and adjust the machines continually to ensure their optimal performance.

Thank you, BLAKE & PENDLETON, for your insights, and congratulations on your 35-year anniversary.

For more information contact Allen King, President, Blake & Pendleton, Inc., Phone (800) 333-6650, email: macon@blakeandpendleton.com, www.blakeandpendleton.com.

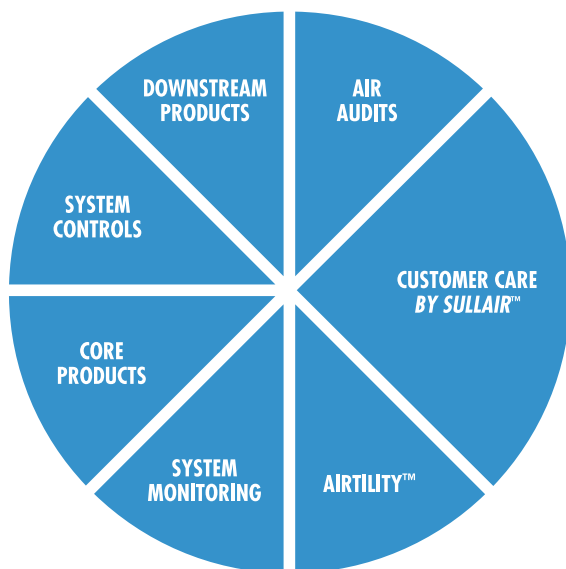


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To learn more about AirMetrixSM, visit www.Sullair.com.
Or call us at: 1-800-SULLAIR or 1-219-879-5451



THE WALKER FILTRATION GROUP

The Walker Filtration Group has an enviable reputation for customer service, innovative product solutions, and off-the-shelf availability of filter housing assemblies and filter elements. The group is now in its 23rd year of providing high-quality purification products to suit compressed air, gas, medical, vacuum, and sterile air applications.

Recognized as an industry leader, Walker Filtration was established with a focus firmly upon the research, design, testing, manufacturing, and distribution of unique and innovative high-performance air and gas filter products.

The month of May this year saw the Group win the Queens Award for International Trade 2006. This is the third time the company has won this prestigious award. The coveted accomplishment recognizes rapid export sales growth and new market penetration.



Corporate Headquarters, U.K.

Expansion into North, Central, and South America

The U.S. market has played a significant role in this growth trend for the Company. To further support the group's existing customer base, March 2002 saw the opening of a light manufacturing warehouse, sales, and technical customer support center located in Erie, Pennsylvania. The North, Central, and South American markets are of key strategic importance to the Groups continued success. To support these markets, the group established a highly capable and enthusiastic team in Erie, which is focused upon providing first class support to existing customers. At the same time, the team is tasked with establishing new customer relations with OEM-type air compressor, dryer, and vacuum pump manufacturers and their distributors.



Walker U.S. Team

The move into the U.S. has proven to be highly successful, due to maintaining focus upon the products and markets the company knows best. The U.S. subsidiary presently has a total of 12,000 square feet of warehousing and office space, which has been carefully planned to ensure that it can maximize the stocking of a vast range of filter products while offering same-day dispatch. As an added benefit to customers, the local UPS distribution center is located within 100 yards of the Walker Filtration facility. This has proven extremely helpful, after usual business hours, in ensuring that they are able to meet customer service goals — regardless of whether the products are specifically branded for the client or not.

Guaranteed Branding Service and One-Stop Shopping

Individual customer product branding has proven to be a very important part of the company's success to date. The Walker Filtration team is highly experienced in the individual branding of filter housing assemblies and filter elements. This enables their customers' corporate identities to be fully incorporated into the product offerings. Walker Filtration OEM and some larger distributor customers have confirmed that this individual branding service has played an important part in their decision to use Walker Filtration as their one-stop shop for all compressed air and gas filtration products



Filter Assembly and Branding Area

One-stop shopping for all the various types of compressed air filter elements is a difficult thing to achieve, as most customers know only too well. Walker Filtration has invested very heavily in the ability to manufacture, package, and stock all types of "Alternative Filter Elements" within the Erie facility. One quick phone call to the Walker Filtration customer service team, for almost all brands of compressed air filter elements, will result in a quick and easy cross-reference being made, a competitive price and fast delivery quote, all for an Alternative Filter Element that is backed by a performance guarantee. The Walker Filtration performance guarantee ensures the customer, that the technical performance of the filter element supplied will be either the same as or better than that of the name brand manufacturer.



Guaranteed Alternative Element Program

THE WALKER FILTRATION GROUP

Company Profile

Vacuum Filter Products

Product performance is high on the agenda for all Walker Filtration products, and the extensive range of vacuum filter product is no exception. The efficient filtration and separation of oil droplets and oil smoke from vacuum pumps is high on the mind of rough and high vacuum rotary vane pump manufacturers. Walker Filtration provides alternative air-oil separators for many world-class vacuum pump manufacturers. All the products are manufactured using a proven Walker Filtration design, which offers the user lower oil smoke carry-over with a reduced pressure drop, thereby extending service life and lowering operating costs.

Vacuum pump separators and other medical vacuum products manufactured by Walker Filtration are also employed within hospital vacuum applications. Held in stock at the Erie facility, these products offer vacuum pump manufacturers peace of mind when servicing such critical items of medical plant equipment.

MICROBAN™ Sterile Air Products

Walker Filtration has for many years manufactured a comprehensive range of high-quality stainless steel MICROBAN™ sterile air filter housings and cartridges for use in critical air applications as used in the pharmaceutical, beverage, food processing/ packaging and medical applications.

Original Walker Filtration MICROBAN™ cartridges plus an extensive range of alternative sterile air cartridges to suit other manufacturers filter housings are held in stock for immediate dispatch.

In addition, the Erie facility has invested in a state-of-the-art product testing facility that enables the user of these high-end filtration products to ship them back to the Walker Filtration Erie facility for integrity testing and reporting.

For more information contact: Richard Taylor, President, Walker Filtration Inc., Phone (814) 836-2900, email: richardp.taylor@walkerfiltration.com, or visit www.walkerfiltration.com

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Doing MORE with LESS

BY R. SCOT FOSS

In the last 20 years, we have gone from “Do a good job” to many new spins on the same subject in the following chronological order:

1. Do a good job and you get to keep it.
2. Do the same good job with less.
3. Do more with less or else.

As the pressures to perform in business mount, new wrinkles on the same theme become more and more threatening. The message from the top never reached the bottom of the organization until recently. There was always some middle to top management types who translated it into a more benign message that motivated instead of frightened people. When all of this is over, an organization and the people in it can only do the best they can.

This brings up a very interesting problem. Most organizations and the people in them are not doing the best they can. In fact, most of us are not performing up to our capabilities. If we are learning at all on a day-to-day basis, there is always room for growth. We are, for the most part, creatures of habit who hate change outside or inside of us.

When the stock market rewarded IBM for accepting the failings of their past and making difficult, if not brutal changes, the massive restructuring of American Industry was off and running. All of us have taken a few deep breaths since this “right sizing” began. Some of us have responded with some very serious moaning and groaning.

As I get older, I have found that acceptance is the solution to all of my problems. I always knew that the situation was difficult. My problem was that I couldn't accept that it was OK for it to be difficult. Once I accepted it, it wasn't a problem anymore. Once I get through this part of the eternal exercise, I am reminded of my father's constant statement when I presented him with my most recent problem... “What ya gonna do?” He wanted me to assign myself responsibility for my problems. I, of course, wanted to give them to him. It never worked. He would always remind me that, “It was never them, never

the situation, it's always me... if I didn't like what was dealt to me... change myself”. Oftentimes this meant “my attitude.”

So here we are with the “Doing more with less” thing on our back. The first thing I have to ask myself is, “What ya gonna do?” How about getting honest about what I am doing. Acknowledging the strength of my activities and shortcomings would be a good place to start. Once I have entirely accepted my shortcomings, change begins with little added effort. We are all limited only by our experiences. Hopefully “experience” is a worthy teacher and not an adversary. It depends if you define experience as what you got when you didn't get what you wanted. If this is your definition, then experience can be your enemy. If we realize that our boundaries are sculpted by what we believe to be true, and realize that we are all incomplete at any one time in our lives, we can dispose of those boundaries and seek new truths. The first practical truth is that I am capable of more than I currently believe I am. This is always true. I may have to think and/or act differently to get a more complete me, but it is a good start.

Organizations are usually in the midst of some reorganization. Move him here and her there. Change the organizational chart. Reassign responsibility. A wise man once said “No matter where you go...there you are”. If the people don't change on an individual basis, all of the organizational clatter will not help. “Doing more with less” is about expanding the capabilities of the people in an organization. It is about approaching a process from an entirely different direction than we have before. It is about the dynamics of the human spirit and it's desire to excel. If we are going to succeed with the new ethics of business, we need to recharge our batteries, punch a hole in the bottom of our cup of knowledge, and set out on new courses of thinking and action.

Scot Foss is president of Plant Air Technology, Charlotte, NC, a solutions neutral company specializing in compressed air systems auditing, retrofit, and design. They have audited more than 2,400 industrial or process compressed air systems worldwide. Their website is www.plantair.com. Mr. Foss has authored an 1,100-page book titled, “Compressed Air Systems-Solution Series” plus more than 70 nationally and internationally published papers and articles. 704-844-6666.

INDUSTRY NEWS

Press Releases

MORE CHOICES IN VARIABLE SPEED DRIVE!

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For more information, please contact Tom Milton at (800) 528-5192 extension 232 or e-mail info@alupcompressors.com



ALUP Combi II

PNEUMATIC PART PRESENCE SENSING FROM REXROTH FOR RELIABLE PROCESS ACCURACY

The new Rexroth MS01 pneumatic part presence sensing system offers precise measuring accuracy up to 0.01mm.

Automatic feeding and processing of workpieces quite often relies on exact positioning of the parts. Rexroth has developed a pneumatic modular system to monitor part presence that fulfills the strictest user demands in terms of technology, user-friendliness, and size.

The new compact system controls the presence, position, shape, and dimensions of test objects. The object is scanned using an air jet from a sensor nozzle. Simultaneous evaluation of the previously defined pressure sends an output to the user in the form of electrical signals. These signals are processed by the machine control system and displayed on the module.

The control system either releases the workpiece for processing or stops the process. This contributes immensely to improving the quality of the test object, but it also avoids errors, thus saving time and money.

This function opens up a wide variety of application possibilities for almost any industry, such as the machine tool or automotive.

The block solution with the proven CD01 valve system can be integrated into any machine control system. Up to six test modules can be combined in the system solution. In addition to this, the technical design of the system makes it insensitive to primary pressure fluctuations. In addition to all these advantages, this system solution requires only minimum effort for assembly and installation.



Rexroth MS01

Pneumatic part present sensing from Rexroth also stands out due to its extremely precise measuring accuracy of up to 0.01 mm. The MS01 is also equipped with an integrated air blowing function to prevent the measured results from being incorrectly influenced by contaminants such as shavings or coolant. Regular surface cleaning is guaranteed with this function. The air blowing function can be regulated to keep compressed air consumption to a minimum, making the MS01 much more efficient than most other pneumatic systems available. A combination of optical and mechanical system components also enables you to quickly and easily set the correct gap limit between the workpiece and the sensor nozzle.

Bosch Rexroth Corporation, a merger of Bosch Automation Technology and Rexroth, is a wholly owned subsidiary of Robert Bosch GmbH. In the year 2003, Bosch Rexroth AG achieved sales of \$4.4 billion (3.7 billion Euros) with 25,700 employees.

Under the brand name of Rexroth, the company offers all relevant drive, control, and motion technologies, from mechanics, hydraulics, and pneumatics to electronics and associated services. Rexroth has 500,000 customers in more than 80 countries and is an extensive supplier of components and systems for industrial and factory automation and mobile applications.

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INDUSTRY NEWS

Press Releases

TENCARVA MACHINERY COMPANY RANKED IN "BIG 50" BY INDUSTRIAL DISTRIBUTION MAGAZINE

GREENSBORO, N.C., July 3, 2006 —

Tencarva Machinery Company, an engineered sales specialty distributor with its corporate office in Greensboro, N.C., has been ranked 48th recently by the national publication, Industrial Distribution, in its "Big 50" list of top U.S. headquartered distributors, based on sales and earnings.



*Tencarva's Headquarters,
Greensboro, N.C.*

The publication indicated that most of the "Big 50" companies reported record sales and earnings, and Tencarva was no exception. Rod Lee, Tencarva's president, says, "Tencarva Machinery Company enjoyed good growth in 2005 as the industrial economy rebounded to some degree. Our total sales were more than 7% above the same period in 2004. Total income was almost 10% ahead of last year."

Tencarva's 2005 sales reached \$105 million through the efforts of more than 220 employees in the 23 branch offices in the 8 states where Tencarva operates. Lee points to an increase in the compressor sales as the general economy became stronger.

Ed Pearce, Tencarva controller, explains, "We are honored to be selected for this ranking. Our 2006 projections are in line with the figures achieved last year. Tencarva recently acquired the Municipal Division of Emory Wilson in Greensboro, N.C., which has significantly increased the company's territory for municipal pump sales as well as for residential and small subdivision wastewater packages."

Tencarva Machinery Company is a distributor specializing in liquid process, compressed air, vacuum equipment, and custom-designed systems for the industrial and municipal marketplace. Tencarva is dedicated to providing the highest quality process machinery, coupled with superior customer service and integrity.

Founded in 1978, Tencarva Machinery is committed to providing superior service by supplying innovative engineering assistance, professional equipment selection, competitive deliveries and parts availability, and preventive maintenance and repair services to all its customers. Tencarva has 23 branches in 8 states, including Arkansas, Florida, Maryland, Mississippi, North Carolina, South Carolina, Tennessee, and Virginia.

For additional details on Tencarva, contact Ed Pearce, controller, at Tencarva Machinery Company, 1115 Pleasant Ridge Road, Greensboro, NC 27409-9753, (336) 665-1435. For information on Tencarva, please visit the website at <http://www.tencarva.com>.

QUINCY COMPRESSOR INTRODUCES NEW QSI 245i-500i

Direct Drive Rotary Screw Compressor Series

BAY MINETTE, Ala., July 7, 2006 — Quincy Compressor Inc., a leading manufacturer of reciprocating and rotary screw air compressors and an EnPro Industries (NYSE: NPO) company, announced the release of its QSI 245i-500i direct drive rotary screw compressor.

The QSI 245i-500i is Quincy's newly designed series of its renowned QSI air compressor, which has been recognized for more than two decades as an industry-leading industrial compressor available in 50, 60, 75 and 100 horsepower.

Customer feedback inspired the new design, including easy-access panels for faster maintenance and the use of a centrifugal fan to increase efficiency and offer quieter operation. The QSI 245i 50 hp compressor with an enclosure operates at 66 dBA, quieter than a home air conditioner.

This new package also introduces innovative technologies like an integrated dryer option, and a full-color touch screen interface, which allows users to view real-time performance, create graphs and customized trends. Plus, the QSI Power\$ync, a variable capacity control option, allows the QSI to reduce its capacity to 50%, providing superior energy savings when the customer does not need the compressor's full output.

Quincy's Royal Blue Warranty, a unique ten-year airend and five-year package warranty, comes with every QSI and is only available from Quincy Compressor.

Founded in 1920, Quincy Compressor is a leading designer and manufacturer of reciprocating and rotary screw air compressors, vacuum pumps and a full line of air treatment components. An EnPro Industries company (NYSE: NPO), Quincy is headquartered in Bay Minette, Ala., and operates locations in Quincy, Ill., and in Kunshan, China. For additional information on Quincy's full line of products, visit www.quincycompressor.com.

EnPro Industries, Inc. is a leader in sealing products, metal polymer and filament wound bearings, compressor systems, diesel and dual-fuel engines and other engineered products for use in critical applications by industries worldwide. For more information about EnPro, visit the company's website <http://www.enproindustries.com>.



Quincy QSI 245i-500i

COMPRESSED AIR SUPPLY SYSTEMS FOR HVAC PNEUMATIC CONTROLS

BY STEVE BYBEE

This document presents engineering data on compressed air systems for HVAC pneumatic controls in commercial buildings. The demand-side of the air system, including the air supply and quality requirements of the pneumatic devices, is reviewed. Supply-side information is also provided for choosing and sizing oil-lubricated and oil-less reciprocating air compressors, filters, dryers, and accessory equipment.

The Demand-Side of HVAC Pneumatic Controls

Air is normally compressed to an average pressure of 80 psig (552 kPa) to enable efficient storage, drying, and filtering. The air pressure is then reduced and distributed throughout the system. Normally, main-air distribution systems are operated between 13 to 25 psig (90 to 172 kPa) pressure, depending on the type of control devices.

Bleed-Type and Pilot Operated-Type Control Devices

The air supply requirement of a pneumatic control system is the air consumption sum of all air-consuming pneumatic control devices in the system. Air consumption of a device is based on the maximum continuous consumption as it operates normally in a system. This is measured in cubic feet of air per minute at standard atmosphere pressure (scfm) or liters per second (l/s) in metric units. Specific device air consumption figures can be found with the technical documentation of the device. Bleed-type and pilot operated-type are the most common pneumatic control devices.

Sizing requirements for bleed-type pneumatic control devices are for maximum air consumption. A bleed-type device uses:

1. Maximum air at minimum branch-line pressure
2. Approximately 90% of maximum air at 8 psig (55 kPa) branch-line pressure
3. A minimum amount of air at the maximum branch-line pressure

Sizing requirements for pilot operated-type pneumatic control devices are for steady state air consumption. A pilot operated-type device uses:

1. A relatively constant amount of air at all branch-line pressures
2. A greater amount of air when the device is hunting. The amount used depends on air volume of the cycled actuators and the frequency of cycling



Quincy Climate Control Package

Clean Air Requirements — Removal of liquid oil and solids

Clean air quality required for commercial control devices is a maximum of 50 micrograms per cubic meter (0.04 ppm) of 0.3 micron or larger particles. A compressed air system furnishes clean, dry air at the proper pressure to all control devices in a pneumatic control system. Clean air prevents clogging of control devices. Most devices contain filters, orifices, nozzles, and valve mechanisms, which are affected by dirt and/or oil accumulation. Orifice restrictions of 0.003- to 0.007-inch diameter are commonly used and cannot be blocked.

It is important that oil to 0.04 ppm be removed from the compressed air. Oil contamination in compressed air appears in gaseous or aerosol forms. Gaseous oil usually remains in a vapor state throughout the system and does not detrimentally affect operation of the controls. Aerosols coalesce (join together) while flowing through the system. These forming droplets collect in device filters, orifices, and small passages where turbulence causes impingement and accumulation. In today's typical control systems, oil contamination results in pneumatic control device failures.

Solids must also be removed to 0.03 microns from the compressed air. Contamination in the atmosphere requires a compressor intake air filter to remove particles, 25 microns and larger, which would interfere with clearances in the air compressor pump. This is critical on oil-less compressors where contaminated inlet air causes excessive wear on piston rings. Downstream of the air compressor and air dryer, oil mixes with fine dirt particles acting as a bonding agent. This causes a buildup of contamination that must be removed by a coalescing filter rated for at least 0.03 micron particulate removal.

Dry Air Requirement — Removal of Moisture

Air should be dry enough to prevent condensation anywhere in the pneumatic system. Condensation causes corrosion. Products of corrosion, such as pipe scale, cause blockage of orifices and valve mechanisms. Dry air also aids a coalescing filter's ability to remove oil and/or dirt.

Pneumatic tubing runs throughout most buildings. The coldest ambient temperature to which tubing is exposed must be considered the criterion for required dryness (dew point) of the compressed air supply. Dew point is the temperature at which moisture starts to condense out of the air. The coldest winter operation exposure is normally a function of outside air temperature. Summer operation exposure is normally a function of temperature in cold air ducts or air conditioned spaces.

The recommended dew point for most applications is 35°F (2°C) at an average compressor-tank pressure of 80 psig (552 kPa). When regulated down, this air is dried to a dew point of 12°F (-11°C) at 20 psig (138 kPa) in the mainline.

It should be noted that in many parts of the country, a lower dew point can be required due to low-temperature winter conditions. The coldest type of exposure is an air-line and control device (such as a damper actuator or temperature controller) mounted on a rooftop air handling unit. The second coldest type of winter exposure is an air-line run in a furred ceiling or outside wall. For example, with an outside air temperature of 0°F (-18°C) and an inside temperature of 72°F (22°C), the pneumatic tubing temperature would be 24°F (-4°C). Depending upon the situation, a pressure dew point as low as -40°F (-40°C) may be required.



Quincy Coalescing Filter

COMPRESSED AIR SUPPLY SYSTEMS FOR HVAC PNEUMATIC CONTROLS

Supply-Side: Application and Sizing of Air Supply Equipment

The Installation

Contamination in the atmosphere requires a compressor intake air filter to remove particles, 25 microns and larger, which would interfere with clearances in the air compressor pump. This is critical on oil-less compressors where contaminated inlet air causes excessive wear on piston rings.

Compressed air from the pump discharge is routed into a receiver or storage tank where flow rate fluctuations are smoothed out. Cooling and settling actions condense some of the excess moisture and allow fallout of the larger oil droplets generated by the compressor pump. This moisture is removed from the tank by a condensate drain.

The high pressure air, from the storage tank, flows into the compressed air dryer, the central station filter, the pressure reducing valve, the relief valve, and then, into the air distribution system. Remote air-consuming devices have individual device filters to catch any contamination introduced into the piping system after the central filter. Individual device filters improve device reliability.

INSTALLATION SEQUENCE OF EQUIPMENT

Dew Point of +35°F (2°C)	Dew Point of -40°F (-40°C)
Intake Air Filter 25 micron	Intake Air Filter 25 micron
Air Compressor	Air Compressor
Receiver Tank*	Receiver Tank*
Refrigerated Air Dryer*	Coalescing Air Filter for Oil to 0.01 ppm*
Coalescing Air Filter for Oil to 0.01 ppm & Solids to 0.01 micron*	Desiccant Air Dryer
Pressure Reducing Valve	Particulate Air Filter for Solids to 0.01 micron*
Relief Valve	Pressure Reducing Valve
	Relief Valve

*Condensate drain attached

**All Condensate should be routed to an oil-water separator for responsible oil disposal

1. Intake Air Filters

The compressor intake filter or strainer is factory designed to match the pump. This filter handles the constant flow delivery when the pump is running. Particles 25 microns or larger are filtered out of the air. This is adequate to protect the pump from abrasion and provides improved air quality. As the filter accumulates dirt, an abnormal pressure drop occurs. This results in excessive oil usage and air contamination in oil-lubricated compressors and a reduction in air delivery.

For this reason, intake filters should be large enough so that their periodic cleaning will coincide with other service activities, such as adding oil or replacing Teflon rings. To a large extent, the compressor environment determines the size requirement of the filter. The filter also attenuates compressor intake noise. Felt filters are not recommended due to inconsistent filtering characteristics.

2. Air Compressors

Compressor Sizing and Starts per Hour

The compressor pump is normally sized to operate up to one-half of the time to provide normal system air consumption. The air storage tank capacity is matched to the pump and is designed to give a reasonable number of cycles per hour. The storage tank



Quincy compressor-tank-dryer package

provides sufficient storage to carry peak air consumption loads. To determine the scfm rating of compressors to be used at higher altitudes:

1. Determine the scfm requirement from compressor
2. Determine the multiplier for the altitude of the compressor provided by the manufacturer
3. Multiply the scfm determined by the multiplier and choose a compressor with the appropriate scfm output at 33% or 50% operation

It may be necessary to determine the effects of sizing, pressure switch settings, and tank size on compressor starts per hour. Air compressors will specify maximum starts per hour. Some smaller sizes will specify no more than 12 while some larger models will enable 30 starts per hour. The minimum bleed-down (off) time should also be calculated.

Oil-Lubricated versus Oil-Less Air Compressors

Oil-lubricated reciprocating compressors have been the standard in the control industry. Oil-less reciprocating compressors have also become an acceptable alternative.

Oil-Lubricated Air Compressors

Oil-lubricated compressors employ either splash lubrication or pressure lubrication by means of an oil pump. In the process of lubricating the piston rings, the cylinder walls become oil coated. This puts oil in the compression chamber, which contaminates the compressed air and requires that oil be added to the crankcase at regular intervals.

Control-quality oil-lubricated compressors have an extra oil-controller piston ring to minimize the amount of lubricating oil entering the compression chamber. These compressors are run at relatively low rpm (typically less than 550 rpm) to prevent overheating. The amount

of oil absorbed by the air is proportional to the heat of the cylinder. The heat generated by a compressor is proportional to the speed and to ON time versus OFF time.

Oil-Less Air Compressors

Oil-less reciprocating compressors use self-lubricating Teflon rings and lifetime lubricated bearings. Therefore, they do not require oil lubrication, and no contaminating oil is introduced in the compressor.

The close fitting rings of the oil-less compressors are more sensitive to contaminating particulates. To minimize contamination, exercise caution in locating the air intake. Oil or moisture-laden air from a contaminated environment passes right through the compressor into the air lines.



Quincy QRD Series Oil-less Compressor

Single versus Dual (Or Duplex) Air Compressors

Air compressors are available either as single or dual compressor assemblies. The single assembly is considered standard; however, many job specifications require dual units.

The dual compressor assembly consists of two separate motor-pump units mounted on a storage tank. This assembly uses a single dryer/filter/prv station, and discharges into a single air distribution system. Through control of an automatic alternator, the two units run alternatively to maintain required tank pressure. The second unit also acts as an automatic standby to maintain pressure should the primary unit shut down. Manual alternation is not recommended. One of the units could inadvertently remain off for a long period of time. This could result in damaged valves.

Dual compressor assemblies provide increased reliability of the air pressure source for critical, automatic control systems. Each unit runs only half the time it would as a single compressor assembly. Reduced run time results in lower head temperature, less oil contamination in the compressed air, and doubles the time between servicing.

3. Air Dryers, Filters and Valves

The selection of an air dryer is based on expected job conditions of moisture in the air and the lowest temperature to which an air-line will be exposed. Two methods of drying compressed air are discussed. These are refrigerated dryers and desiccant dryers.

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COMPRESSED AIR SUPPLY SYSTEMS FOR HVAC PNEUMATIC CONTROLS

Refrigerated Air Dryers

Moisture, in compressed air, is removed by an increase in pressure and/or a decrease in temperature, or both. When air is compressed and/or cooled beyond its saturation point, moisture condenses. Draining this condensate causes some drying of the air supply.

Using the principle of cooling to create condensation, the refrigerant dryer is the most common means of attaining dry compressed air. It provides the greatest system reliability and requires the least amount of maintenance. Using a noncycling operation with a hot gas bypass control on the refrigerant flow, the refrigerant dryer provides a constant dew point of approximately 35°F (2°C) at the tank pressure. Direct, air-to-refrigerant exchangers provide efficient operation. The refrigerant system is hermetically sealed to prevent loss of refrigerant and lubricant and to protect against dirt. The dryer includes a separator for efficient liquid removal and condenses both water and oil. An automatic drain exhausts the generated condensate.

A service air bypass valve is suggested before the air dryer to permit maintenance to be performed without interruption air supply.

Desiccant Air Dryers

For installations requiring lower dew points to -40°F (-40°C), desiccant air dryers are recommended. These dryers use the adsorbant principle of operation. The porous desiccant material in the dryer, commonly activated alumina, adsorbs water and water vapor into its pores. The material is regenerated using a portion of the dried compressed air at a reduced pressure. This is the regeneration process suggested for these relatively low airflows.

A desiccant dryer requires an oil coalescing filter to be installed before it. This prevents oil from clogging the pores of the desiccant material. It also requires a particulate filter to be installed after it, to prevent desiccant dust from going downstream.

Air Filters

Oil coalescing air filters are required to remove oil aerosols from the air stream. These filters use filter elements constructed of blended fibers capable of coalescing oil mist into larger droplets in the fibers. The coalesced liquids gravitate to the bottom section of the outer surface of the filter element and drop off into a sump. Here, they are automatically discharged by a condensate drain.

Particulate filters remove all solids present in the system through the use of blended fiber media. A differential pressure gauge provides an indication of when the element is blocked with particulates and requires maintenance. These gauges normally are set at 10 psig to indicate a change-out.

Valves

The Pressure Reducing Valve (PRV) is located after the air filters. Sizing the PRV is done in accordance with the control characteristics of the model. The pressure relief valve is normally positioned downstream of the pressure reducing valve to protect equipment from damage in the event of a PRV failure. These relief valves are sized to safely pass the amount of air supplied by the air compressor.

Pneumatic controls for HVAC systems will operate reliably with the support of a well-designed compressed air system. Understanding air demand, air quality requirements, and selecting the appropriate equipment makes this possible.

For more information contact Steve Bybee, Director of Marketing Light Industrial, Quincy Compressor, email: Steve.Bybee@quincycorpressor.com, Tel: 217-277-1312

Compressed Air Best Practices

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ENERGY-EFFICIENT DESICCANT AIR DRYERS

BY JOSEPH A. FRESCH

INTRODUCTION

How should you go about selecting the most energy-efficient desiccant dryer for your operation? Start by learning the facts, features, and costs (both operating and capital) of the different models that are available to choose from. Put the information in a decision matrix and the choice should become quite clear.

Let's start with some assumptions. You have already determined that you need a pressure dew point of -40°F or better or you wouldn't be considering a desiccant dryer. Assuming further that you are looking at a total plant usage of 1,000 SCFM or more, the choice may in fact be different for a smaller plant facility due simply to capital cost structure of the different types of desiccant dryers. Let's also assume that the most common types of desiccant dryers are available for your consideration, namely:

- Heatless Pressure Swing
- Blower Purge (with External or Internal Heater)
- External Heat Reactivated Dryer
- Heat of Compression

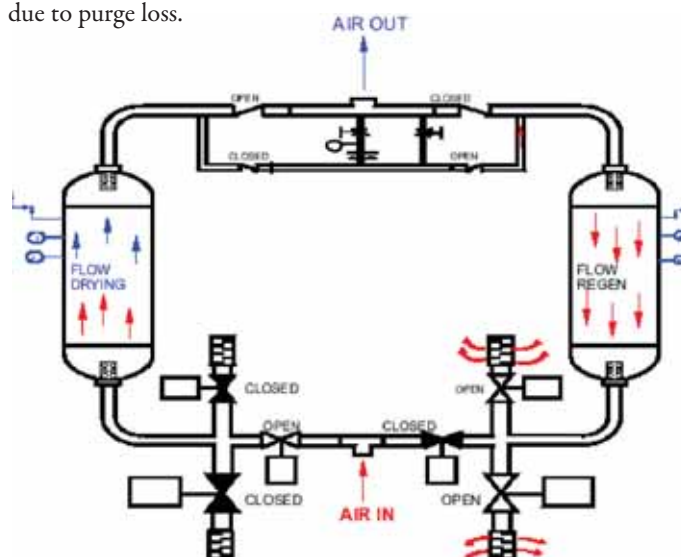
There are other types of desiccant dryers in the market, but for the purpose of this article we are only considering mainstream, commonly available technologies.

The approach of this article is to find the most energy-efficient desiccant dryer solution available and submit that as a "Best Practice" for industrial compressed air usage. We begin with a review of the most common desiccant dryers available.

TYPES OF DESICCANT AIR DRYERS

Heatless Pressure Swing

Commonly called a heatless dryer, these dryers use a portion of the dried compressed air, usually 14–15%, to purge the off-line tower while the on-line tower is drying the air. The cycle is usually a 10-minute NEMA cycle, 5 minutes drying, followed by 5 minutes of regenerating as the towers switch positions from on-line to off-line every 5 minutes. These dryers have no trouble reaching a -40°F or -100°F pressure dew point, have very low capital costs with very high operating costs due to purge loss.



ENERGY-EFFICIENT DESICCANT AIR DRYERS

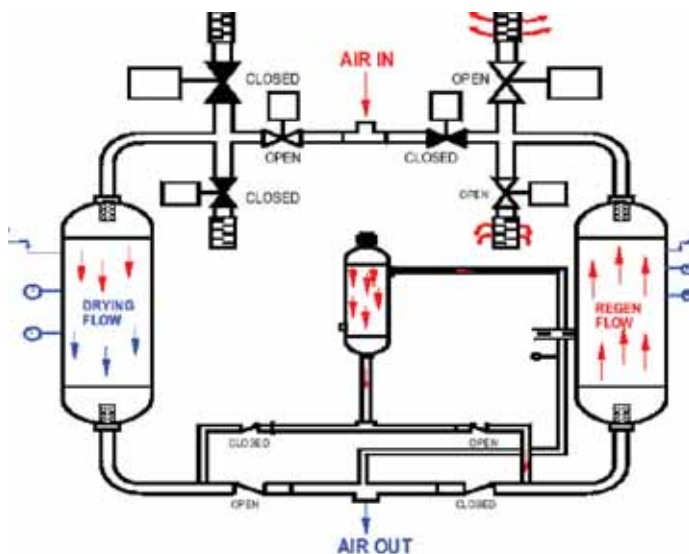
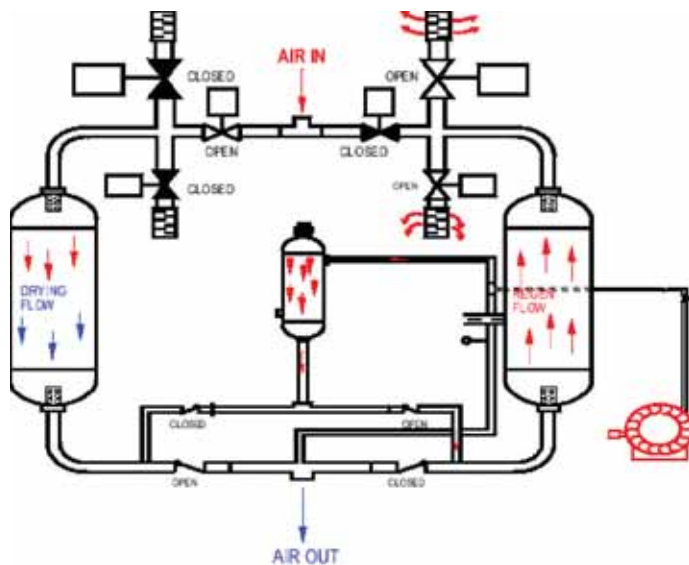
Blower Purge with External or Internal Heater

Blower Purge dryers use none of the process compressed air to regenerate the tower of desiccant. Rather, a low pressure blower ingests ambient air, pressurizes the air to approximately 3–5 psig, and moves the air over a heating element — either in an external heater shell or an internal heater mounted inside the

desiccant tower. This hot ambient air passes over the desiccant bed in the tower, stripping the moisture that it collected while drying the process air stream. These dryers usually have an 8-hour NEMA cycle, 4 hours of drying, followed by 4 hours of regeneration (3 with heated ambient air and 1 hour with ambient air with the heater turned off to cool the desiccant bed). The towers switch positions from drying to regenerating every 4 hours. Dewpoint consistency is an issue with blower purge desiccant dryers reaching a -40°F pressure dew point during the drying cycle, but dew point spikes up to 0°F or higher are not uncommon at switchover due to the use of wet ambient air to regenerate. Some manufacturers will add a polishing cycle of dry air or dry air sweep, using a portion of the dried compressed air to cool the bed in an effort to minimize the dewpoint spikes.



Heatless Pressure-Swing Dryer



Externally Heated Regenerative Dryers

Externally heated regenerative dryers will use a portion of the dried compressed air to regenerate the bed, typically 7%, to purge the off-line tower. An 8-hour NEMA cycle means 4 hours of drying, followed by 4 hours of regeneration. The regeneration cycle is made up of 3 hours of heating the dry purge air, which will strip moisture from the off-line tower and an hour of cool, dry air purge (the heater is simply turned off during this period), which will bring the off-line tower down closer to normal operating temperature of the drying system, typically 100°F . This cool air purge keeps the dew point very consistent and stable throughout the entire cycle. Dew points of -40°F to -90°F or lower are easily achievable with this type of dryer.

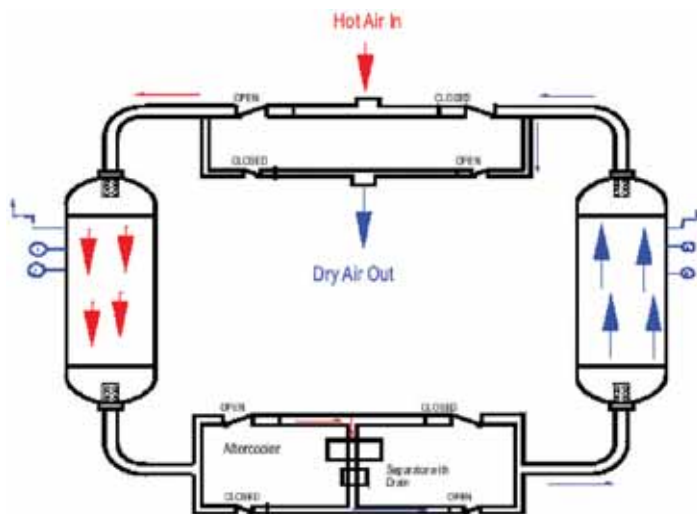


Externally Heated Regenerative Dryer

Heat of Compression

These dryers are only an option if you have an oil-free compressed air system because 100% of the hot air stream directly from the compressor is passed first through the regenerating tower before going into an aftercooler, which cools the air stream prior to passing through the drying tower. No process air is lost during regeneration. The oil free compressors, however, must generate the air with enough heat to regenerate the bed, typically a minimum of 275°F , otherwise the regeneration will not be complete and the dryer will not achieve the required dew point. This dryer also operates on an 8-hour NEMA cycle, with towers switching every 4 hours and is subject to

dew point spikes from -40°F to $+20^{\circ}\text{F}$. If the above conditions describe your plant and you can live with dew point spikes, this dryer can be a very low-cost dryer to operate.



CONTROL SCHEMES

There are many different control schemes offered by the different dryer manufacturers, but suffice it to say that they can all be lumped into two generic categories: partial load controls and full load controls.

Partial Load Controls

Most all companies offer some sort of a partial load control. These controls save energy, in this case purge air, if there is a partial load on the dryer. Let's say you have a 1,000 SCFM regenerative dryer covering all the compressors in your system. On any given day, the load on that dryer may change from 50% to 95% and back again, depending on your plant's operation. During periods of partial load, not as much moisture is being stripped (or adsorbed) by the desiccant, so in theory a tower that has been fully regenerated, should be able to provide drying capacity for a longer period of time than the traditional 5 minutes or 4 hours (depending on the type of dryer above). In practice, the dew point of the air exiting the drying tower will stay lower longer, during periods of partial load, and this will be reflected in the dew point readout on the dryer. Most dryer manufacturers will monitor either the dew point of the air, or the moisture front as it travels through the drying tower. If the drying tower is not fully saturated, then the sequence timer will turn off, delaying tower switchover, until the dew point of the air reaches the prescribed target, say -40°F , at that point the sequence timer resumes and the operation continues normally to a tower switchover. Some dryer manufac-

tures will go ahead and switch towers but not purge until the prescribed dew point is reached. Either way, the effect is to use less purge air for extended periods of partial load on the dryer.

Full Load Controls

Full load controls are controls that will operate no matter the load condition on the dryer. Currently only two dryer manufacturers offer a full load control on their externally heated regenerative dryers, due to patent restrictions. As discussed above, the normal sequence of operation is made up of 3 hours of heating the purge air that will strip moisture from the off-line tower and an hour of cool air purge, where the heater is turned off. When this full load control is activated, periods of heated purge are followed by periods of tower repressurization and holding, where both the purge is suspended and the heater will thermostatically turn off. This results in a significant savings in the operation of the dryer, even if the dryer is operating at full load.

CAPITAL & OPERATING COST COMPARISON

1000 SCFM DRYER, \$0.10/KWH



CAPITAL COST COMPARISON		OPERATING COST COMPARISON		
		1,000 scfm	\$0.10/kWh	PAYBACK Yrs.
Heatless	\$16,190	651.4	\$23,776.10	N/A
Blower Purge	\$33,255	563.0	\$20,549.50	5.3
External Heat (No Blower)	\$23,275	489.0	\$17,848.50	1.2
External Heat with Full Load Control	\$31,100	221.8	\$8,095.70	0.95
External Heat with Full & Partial Load Control	\$31,310	151.8	\$5,542.16	0.8

The charts above show that paying more for a particular dryer does not always translate into energy savings. With a Heatless dryer as a baseline, we are comparing capital cost investment and operating costs for 1,000 SCFM dryers assuming \$0.10/kWh.

Blower purge dryers, while not using any process air for purging will not pay back an additional investment for more than 5 years, when compared to a Heatless Dryer! An External Heat Dryer, on the other hand will payback in just over a year with no controls and in under a year with both a full and a partial load control.

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CONCLUSIONS

When looking for a desiccant dryer, you must find a dryer company without a bias, that is, one that makes many different types of desiccant dryers. They should be able to help guide you towards the best desiccant dryer application for your particular plant.

That said, an external heat desiccant dryer using process air to purge the off-line tower, and outfitted with full and partial load controls, provides many energy-saving benefits when compared to the most common types of desiccant dryers. Consistent dew point with no dew point spikes and no extra maintenance of rotating equipment also are why this dryer should be considered a "Best Practice" for plant compressed air systems.

Joseph A. Fresch—Vice President Marketing and Sales
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3	210	25-49	150
4	195	50+	135

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PIPING

THAT IMPROVES THE BOTTOM LINE

Aluminum Piping Systems Improve Airflow, Save Energy, and Reduce Labor Costs

BY PAUL JOHNSON

Quick-connecting aluminum piping systems (APS) are enabling many plants to increase productivity and reduce costs.

Designed for both primary and secondary distribution of compressed air, vacuum, and inert gases, APS provides several advantages. It reduces energy consumption, improves operational efficiencies, and minimizes installation and maintenance costs.

An APS includes aluminum piping, flexible hose, pipe hangers, quick-assembly brackets for air drops, and air shutoff ball valves.

Energy Savings

Energy costs associated with a compressed air system are significant. For example, when analyzed over a 10-year period, the cost of energy consumed by an average compressed air system exceeds other costs, including the initial cost of equipment and installations.

System pressure drops are one cause of inefficient energy use. For instance, a 14.5 psi pressure drop uses 10% additional energy. Drops can result from a number of sources, including poor system configuration, interior pipe surface corrosion, and compressed air contamination.

“Air leaks, inherent in threaded steel piping systems, also waste energy.”

System configuration. Poor system configuration can lead to improper airflow. The flexible hose used in an APS eliminates many of the layout constraints encountered with rigid piping systems. It accommodates physical obstacles and provides a link between the compressor and piping.

Corrosion. Interior pipe corrosion is a common cause of pressure drops and higher maintenance costs. Smooth bore piping, such as plastic and aluminum, resist corrosion. Figure 1 compares the annual operating costs of galvanized steel, plastic, and aluminum piping.

Compressing ambient air to the discharge pressure introduces moisture into supplied air. Unfortunately, after coolers, filters and dryers do not completely eliminate moisture and its destructive results. As a result, steel pipe systems will begin to corrode, thereby inhibiting smooth airflow and reducing system pressure.

Pipe corrosion also increases compressed air system maintenance. Steel pipe systems need to be dismantled and inspected to monitor corrosion buildup. Not only does replacing corroded pipe interfere with production, it causes rust, corrosion, and other particles to be released into the air system, thereby causing tool and machine operation problems or damage.

PIPING THAT IMPROVES THE BOTTOM LINE

Air contamination. Air cleanliness is another factor that affects consistent airflow. Dirt and dust particles passing through the piping system are gradually deposited on the interior surface of piping. As these deposits accumulate, friction increases and system pressure decreases. Black iron and galvanized steel piping systems are more prone to buildup than stainless steel. Meanwhile, smooth bore piping materials, such as plastic and aluminum, offer the most resistance to deposit buildups. Figure 2 compares the pressure drop characteristics between black iron, galvanized steel, and aluminum piping.

Air leaks, inherent in threaded steel piping systems, also waste energy. Difficult to trace and repair, they can have a huge impact on operating budgets. With its bubble-tight seals, an APS offers virtually leak-free performance.

Simple Installation

Labor accounts for 20–35% of the cost of installing an APS. By comparison, labor accounts for 60–80% of a steel system, 50–70% of copper system, and 40–60% of a plastic system. The astronomical climb of both steel and copper prices makes the APS total installed cost (material cost plus labor cost) far more attractive.

The materials and modular design of an APS makes it easier and less expensive to install than traditional systems. Aluminum piping, such as Transair, is easier to lift and handle than standard steel piping, and its push-to-connect fittings secure connections with a simple push. The fittings eliminate the need for special tools, pipe preparation, and threading. They also eliminate the time needed for soldering and glue drying. And once the pipe is pushed into the fittings, the connection is secure and ready to be pressurized.

Layout Flexibility

Successful operations need to be able to take advantage of new equipment options and automation techniques without incurring lengthy downtime and expense. Consequently, the ability to reconfigure production layouts or implement process changes quickly is critical. An APS, such as Transair, makes reconfiguration practical and efficient.

Because the fittings are not soldered or glued, the components are reusable and can be removed and reinstalled. The modular design and handling ease enable plant personnel to implement many layout changes within minutes, not hours. This minimizes downtime and increase plant productivity.

Improving productivity while reducing operating costs is a goal shared by nearly every manufacturing plant. An APS can help make that goal a reality.

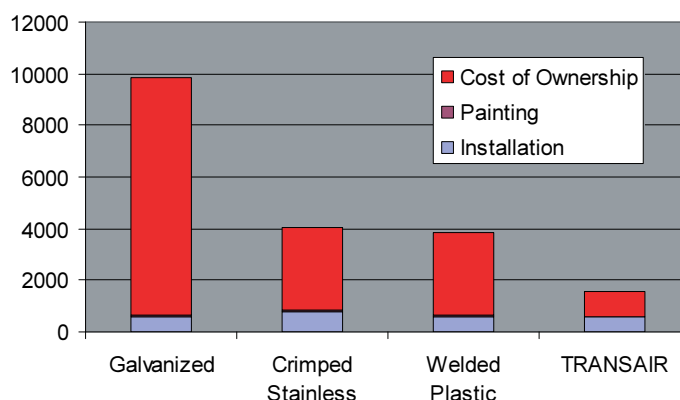


Figure 1: Comparison of the annual operating costs of galvanized steel, stainless steel, galvanized plastic, and aluminum piping (Transair).

Comparison of Transair Pipe vs. Traditional Pipe Systems Pressure Drop at 100 ft. for 40mm at 100 PSIG

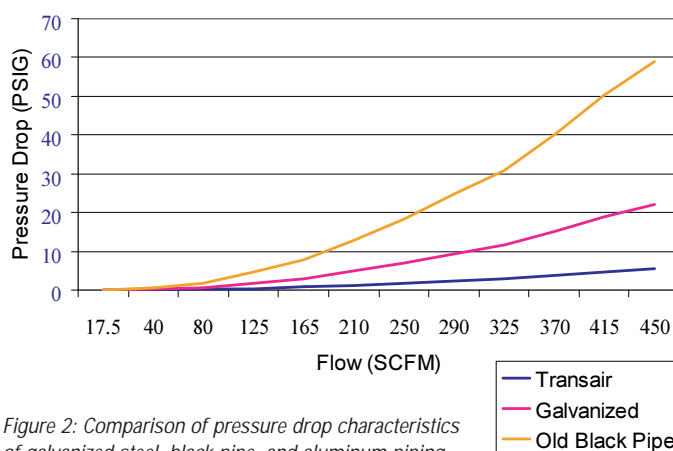


Figure 2: Comparison of pressure drop characteristics of galvanized steel, black pipe, and aluminum piping (Transair).

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ATTENTION

ATTENTION TO CONDENSATE DRAINS REDUCES AIR LEAKS

BY JOHN HAYS

Did you know that every tenth power station operates solely to produce electricity for air compressors? In 2001 there were some 320,000 compressors in the European Union that were consuming some 80 billion kilowatt-hours per annum. One of the primary components of “artificial demand” is air leaks in a factory. A common location for an air leak is wherever condensate drains are located. Condensate drains, when NOT properly selected and maintained, can be a major source of air leaks.

Condensate drains are used in compressed air systems to remove water and oil, in liquid form, from the compressed air system. They are commonly located at the bottom of air storage tanks, within refrigerated dryers, and wherever a filter exists that is separating moisture and oil from the compressed air stream. The success of air purification equipment, such as filters and refrigerated dryers, depends upon the condensate drains’ ability to evacuate the condensate from the compressed air system. The optimum condensate drain system will reliably discharge condensate without losing (leaking) and compressed air in the process.

Commonly used with coalescing filters, float-operated condensate drains are particularly susceptible to dirt deposits. Dirt deposits, such as thickened oil residues, and pipe scale can clog up the moving parts of the float-drain mechanism in the filter. If this happens when the condensate outlet valve is closed, condensate will accumulate and eventually be re-entrained into the air-flow on the clean side of the air filter. This effectively puts the filter out of action. Quite often the fault is only detected when entire production batches have to be scrapped due to the presence of the dirt deposits and liquids that were not discharged by the drain. In addition to this direct loss, the costs are also pushed up by the production standstill and the necessary cleaning of the entire compressed-air system.

Should the float-mechanism get “stuck” when the valve is open, the system now has a significant air leak. Air compressors, particularly during the second and third shifts, will often run only to compensate for the leakage. If the total air requirement (compressed air application plus leakage) exceeds the amount supplied by the compressor, the system will no longer be able to maintain the specified operating pressure. A pneumatic screwdriver, for instance, would then no longer be able to produce the necessary torque.

The air-leak costs for such a float-operated drain should not be underestimated. Each leaking float-type drain can cost up to \$2,769 per annum (assuming only 20 scfm, 115 psi, and 4,000 hours per year).

Time-controlled solenoid valves for the discharge of condensate represent another alternative. These devices are more reliable; however, they do not function in response to the actual demand. The most common installation point is discharging condensate from refrigerated dryers. Time-controlled solenoid valves have two settings. The first setting controls how long the valve is open. The second setting sets the time interval between openings (or condensate evacuation). In order to ensure that the dryers can be used in all parts of the world, the valves are usually factory-set for “worst case” conditions (tropical climate, very humid and warm) to ensure that all liquid is discharged from the compressed air system. The result is that whenever there is less condensate being generated for whatever reason (lower relative humidity, lower flow, lower temperatures) the timed solenoid will not react automatically and close. The drain valve will remain open for the prescribed period and simply dump compressed air into the ambient air thus representing another air leak.

A third technology is the electronic, no air-loss demand drain. This technology uses a sensor that identifies the amount of condensate and triggers a valve to open to remove the condensate. The same sensor also tells the valve to close when the condensate level has been lowered. In this manner, no compressed air is discharged from the system. The drain also protects against dirt deposits by completely isolating the discharge valve. This eliminates the danger of the valve being stuck open or closed.

The fastest place to begin a leak audit is with the condensate drains. The easiest way to ensure reliable and efficient condensate discharge is with electronic, no air-loss drains.

For more information contact:
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Corporation, Phone (704) 663-6621,
email: JohnHays@bekousa.com,
www.bekousa.com



Fig. 1: The electronic, no air-loss BEKOMAT condensate drains. More than 1,000,000 devices installed worldwide.

JOB MARKET

Job Openings in the Compressed Air Industry

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REGIONAL SALES ENGINEER (2 POSITIONS) NORTHERN ILLINOIS/SOUTHEAST WISCONSIN

GRS Fluid Handling is working on a search for a leading company in the fluid handling industry, searching for a top sales engineer, one who can sell products directly to OEM and End User Accounts. For the right candidate, this position could be a terrific opportunity, and will offer:

- Great future promotional opportunities
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- 3-5 years experience selling compressed air/rotating equipment products to automotive accounts
- Ability to travel as necessary
- Residence in or within a 2 hour drive of Detroit
- A technical degree is strongly preferred.

This position offers a chance to advance a career while working for a leading manufacturer. The company is stable, yet growing, and has a history of success.

For more information on these positions, any other positions we are working on, or to learn more about GRS and GRS Fluid Handling's recruiting services please send an e-mail to us at cbac@grsrecruiting.com.



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Compressed Air Best Practices

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12x per year: \$84.00* inch, reversed ad)

*reversed ads = 1.5x normal price

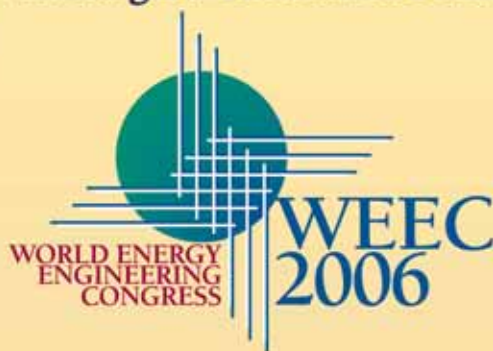
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