Nitrogen Audit at Boeing | VFD Wiring | Industrial Lighting Audit

January 2009

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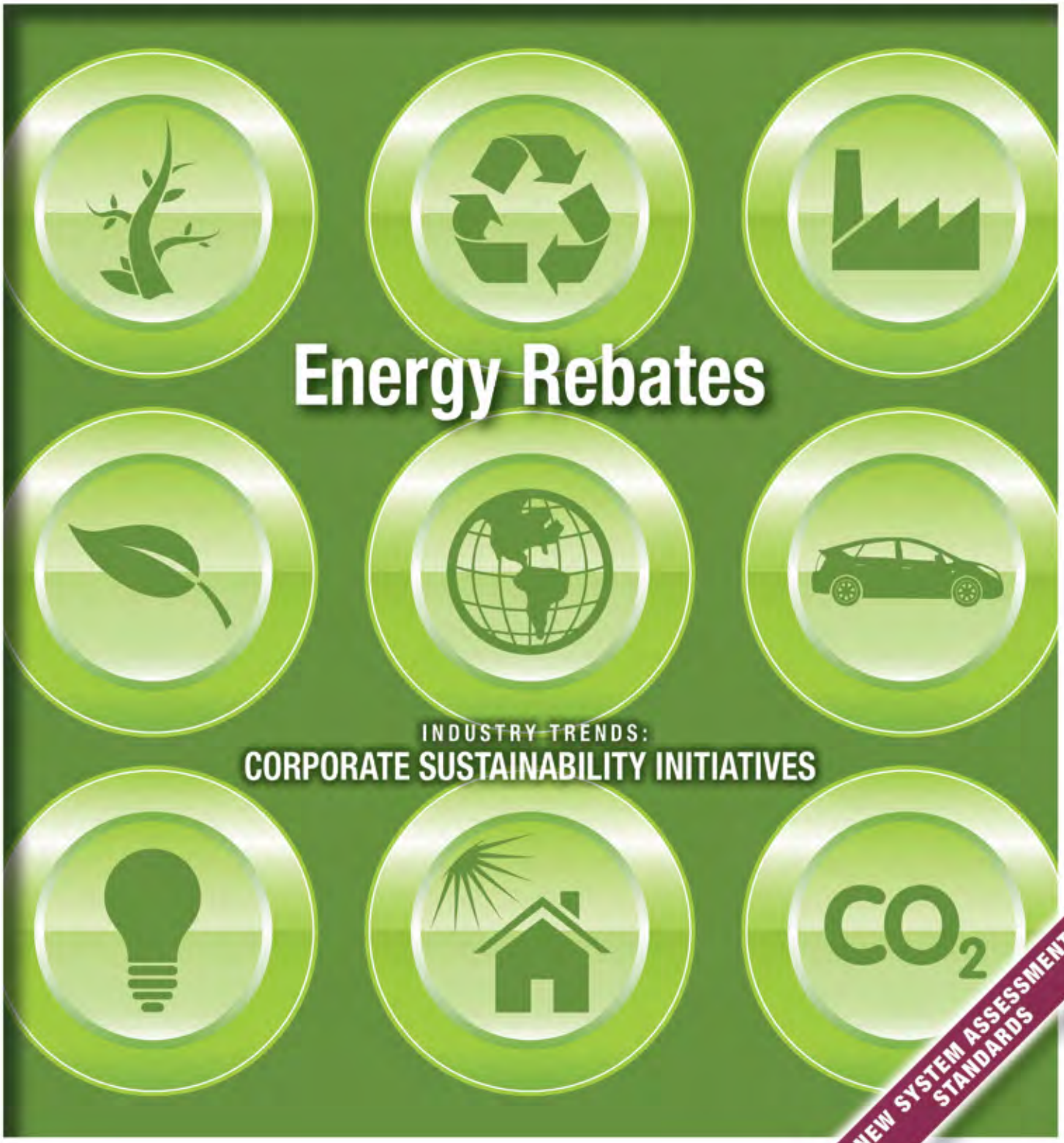

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Frank Moskowitz is an AirMaster+ instructor and a Compressed Air Challenge Fundamentals and Advanced instructor. His articles have been published in Plant Services magazine, MRO Today, and Energy Matters magazine.

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About Atlas Copco-
We are the largest compressor manufacturer, largest compressed air audit company, and largest dryer manufacturer in the world. We were the first to offer energy-saving Variable Speed Drive technology and have developed advanced central controller technology. Innovation drives our business and we have knowledge to share.

Date	Location	Phone Number	Contact
Feb 10, 2009	Charlotte, NC	336-725-2395	Jessica
March 11, 2009	Chicago, IL	847-981-8995 x200	Giuliana
May 20, 2009	Seattle, WA	206-244-3818	Rawleigh

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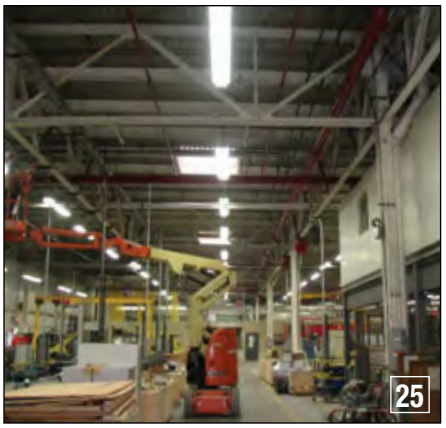

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COMPRESSED AIR INDUSTRY ARTICLES

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FROM THE EDITOR

Incentive Programs for Sustainability

The great thing about "Sustainability" is that one doesn't have to own Birkenstock's to like it. Many moons ago, I hunted aluminum cans near choice farm ponds for the profit of it. The fact that I was cleaning up after high schoolers on the lamb was a nice after-thought. So it is today with industrial kWh reductions in factories. Reduce kWh and improve plant profitability — and then cash in on the goodwill of CO_2 reductions!

Sustainability in Operations is focusing more on the kWh cost of processes than ever before. Every month I am meeting new "Corporate Energy Managers" and "Energy Engineers" tasked with reducing energy costs across 39 or 85 factories. There is a hiring boom going on in this area. Auditing friends of mine tell me of new Energy Managers appointed at large corporations who are then asked to "get out there and reduce energy costs as fast as you can!"

Reduce kWh and improve plant profitability — and then cash in the CO_2 reductions!

Needless to say, these Corporate Energy Engineers need help. Compressed air audits are high on their priority lists and we are very pleased that new system assessment standards are being developed by ASME and ISO. Mr. Wayne Perry has outlined for us the work that is being done in this area to help standardize and define required processes for professional system assessments.

Corporate Energy Engineers are looking at the entire factory for kWh reduction opportunities. For this reason, we provide an Industrial Lighting Audit story, from Thomas Mort in this months' edition. This is the first time we've published an article on an energy-saving opportunity outside of compressed air and blower/vac systems. Please drop me a line if you think we should/should not continue providing stories on energy-saving opportunities outside of compressed air.

Finally, a tremendous catalyst for Sustainability is Energy Rebates. When the utility companies and/or the government provide incentive programs, more projects get done. Corporate confidence in the ROI of efficiency projects improves tremendously when rebate dollars are awarded. If the new administration wants to revolutionize energy consumption to the downside, I hope they look at funding public and private energy rebate programs.

Thank you again for your support and for investing in industrial energy efficiency.

ROD SMITH
Editor
rod@airbestpractices.com

UTILITY-AIR NEWS

Atlas Copco Launches Custom Design Center in U.S.

Atlas Copco Compressors has announced the launch of a United States-based Custom Design Center, formalizing the specialized compressor solution division that was created through Atlas Copco's 2006 acquisition of Tide-Air.

The new Atlas Copco Custom Design Center, which is based in Houston, Texas employs 25 people who specialize in customizing compressors and packaging solutions of all sizes for special applications. The creation of this division continues the tradition of service that Tide-Air has been providing to customers across a broad spectrum of industries since 1971.

"The Tide-Air acquisition has provided tremendous opportunities for us both in terms of our product capabilities and the development of our people, and we felt the time was right to rebrand our business inline with the Atlas Copco group," said Rob Ryan, vice president engineered products for Atlas Copco Custom Design. "The talents of Atlas Copco Custom Design combined with the products and worldwide service capabilities of Atlas Copco provide us with a real competitive advantage."

The birth of Atlas Copco Custom Design in the U.S. is the latest in a development of Atlas Copco Custom Design centers across the globe, including locations in the U.K., Belgium, India and Brazil. Atlas Copco Custom Design in Houston will keep the identifier "formally Tide-Air" under its new operating name for the next six to 12 months to help in transitioning from Tide-Air, a highly respected name within the oil and gas industry, as well as other markets.

Atlas Copco Custom Design Instrument Air Package

UTILITY-AIR NEWS

"Atlas Copco Custom Design, formerly Tide-Air, has been a tremendous acquisition for Atlas Copco in the United States," commented Paul Hense, president of Atlas Copco Compressors in the U.S. "The expertise they have demonstrated in providing customers with customized packages has provided real value for both our customers and the Atlas Copco company."

Atlas Copco Custom Design's 26,000-squar-foot facility is specially equipped for compressed air system manufacturing and packaging. They have extensive heavy lifting capabilities and can test beyond 1,000-hp electric drive compressors (50 or 60 Hz) and 1,000-hp natural gas engine drive compressors.

Their welders are certified and proficient in all types of welding, which enables them to manufacture custom systems and adapt standard systems to specific customer applications. Custom painting and coatings are done in their in-house paint booth.

They provide ergonomic packages designed in the smallest footprint and with the lowest noise available, while maximizing energy efficiency and protecting production. They specialize in creating modular custom-built compressed air systems including the compressor(s), dryers and air receivers all on a single base frame. Examples of packages include:

- Special electrical requirements such as Class 1, Group C&D, Division 1 & 2 NEC, IEC, CSA
- PLC control systems
- Extreme hot and cold environments
- Offshore applications
- Instrument air applications
- Starting air applications
- Plant air applications
- Refinery service
- Emergency backup air applications

For more information, visit www.atlascopco.com

Ultrasound World V Announces Keynote Speaker for January Conference

UE Systems will host its fifth annual Ultrasound World conference, scheduled from Sunday, January 18,. 2008 through Wednesday, January 21, 2009 at the Clearwater Hilton Resort in Clearwater Beach, Florida.

UE Systems recently announced additional guest speakers to its original lineup, including keynote speaker, Richard Smith, Senior Technical Advisor for Allied Reliability, Inc. Additional speakers added to the conference agenda include: Martin Robinson, Incorporated Engineer for IRISS, Dean Wolever and Lloyd Hopper, Energy Savings and Maintenance Managers for the Herman Miller Company, Terry Harris, Owner of Reliable Process Solutions, and Bruce Baughman, Senior Vice President of Engineering and Technology for GreenHunter BioFeuls.

Ultrasound World offers a series of technical presentations and informative case studies presented by some of the industry's most experienced ultrasound technology users. Each featured guest will provide insight into their experience with ultrasound and other inspection technologies in the form of case histories that have led to significant energy and equipment savings as well as company/client profitability. Examples of their presentations include:

Generating Savings from an Ultrasound/Infrared Inspection Program

Lloyd Hopper and Dean Wolever will be discussing the benefits and experience they have had with their predictive maintenance program utilizing ultrasound technology to calculate cost savings — including a recent $250,000 savings in leaks alone. They will review three locations they are currently surveying and how ultrasound instrumentation, in addition to an infrared camera, have helped to quickly detect several potential areas of failure.

Building the Ultimate Reliable Plant

Terry Harris and Bruce Baughman will talk about how designing and building reliability into new plants or modifications to existing operations is the wave of the future. They will review how manufacturing plants can be designed, redesigned and built to be 10 times more reliable and five to 10 times more profitable to the bottom line.

For further information about Ultrasound World V's complete lineup of featured speakers or to register, you can visit UE Systems' website at www.uesystems.com and follow the Ultrasound World V link for complete conference details.

For more information contact:
Doug Waetjen, UE Systems
tel: 914.592.1220
info@uesystems.com

NEW START UP ANNOUNCEMENT
BelAir / Nortek Corporation

Speciality Fluid Dehydration And Chiller Products

Mike Zarif, one of the founding members of AirCel Corporation, with 20 plus years of compressed gas treatment and fluid cooling experience, has announced the formation of BelAir / Nortek Corporation. The new Company will open an assembly facility in the Knoxville, Tennessee area specializing in engineered products for industrial use in gas separation, dehydration and fluid chilling.

Mike has an advanced mechanical engineering background. He has designed and developed products for the compressed air industry, fluid chillers for general industry and specialty gas separation products for medical, electrical and other uses. Several patents have been issued on these product offerings.

The Company BelAir Technologies, LLC will join Mike in the start up of this Company and will support the marketing efforts of the specialty produc ts through its existing sales channels.

The Company will be open for business December 15, 2008. Please contact Mike Zarif at 865-403-9209, mzarif@charter.net or Bill Thomas at 720-209-9502, wthomas@belairtech.net for further information.

BelAir Technologies, LLC

NORTEK Compressed Air & Gas

Compressed Air Audit of the Month

Nitrogen System Innovation at Boeing

By Ron Marshall, CET, CIM, Manitoba Hydro

Nitrogen System Innovation at Boeing

Boeing Canada has replaced their on-site membrane style nitrogen generator with a new more modern system with increased capacity and higher efficiency. As a result, the company is now using minimal amounts of expensive liquid nitrogen and has reduced the energy cost per unit of gas produced by 83%.

Inert Environment Required

Boeing uses nitrogen to provide an inert atmosphere for pressurizing the large autoclaves at the company's Winnipeg production facility. These autoclaves operate like huge pressure cookers, heating and curing the various composite aircraft parts fabricated by production personnel. The parts made in Winnipeg are used on such high technology products as the new Boeing 787 Dreamliner. These parts are baked in the autoclaves under a combination of heat, vacuum and pressure to ensure the layers of composite material successfully bond together to provide the necessary strength to form strong, safe and lightweight aircraft fuselage parts.

January Audit of the Month

Where:	Winnipeg, Canada
Industry:	Aircraft Part Fabrication
Issues:	Insufficient Nitrogen Volume and High Costs
Audit Type:	Nitrogen System for Autoclaves

System Before Audit

Annual Energy Use	2,150,000 kWh
Equivalent CO_2 Emissions	1,533 metric tons
Annual Energy Cost	$55,685
Annual Peak Demand Cost	$19,115
Total Annual Energy Cost	$74,800

System After Project Implementation:

Annual Energy Use	491,500 kWh
Equivalent CO_2 Emisions	350 metric tons
Annual Energy Cost	$12,730
Annual Peak Demand Cost	$0
Total Annual Energy Cost	$12,730
Liquid Nitrogen Savings	$30,000

Audit Savings (Annual):

Reduction in Energy Use	1,658,500 kWh
Reduction in CO_2 Emissions	1,183 metric tons
Equivalent CO_2 for homes	157 homes
Equivalent CO_2 for vehicles	217 vehicles
Total $ Savings	$62,070

This massive autoclave requires 69,000 cubic feet of nitrogen at a flow rate of 3,450 cfm to fill to 100 psi in 20 minutes.

Old System Inefficient

Many years ago Boeing had installed an on-site nitrogen generator to provide lower cost gas than could be provided by trucked-in liquid nitrogen service. This system used a 250 horsepower (hp) two-stage high-pressure screw air compressor to feed a membrane-style nitrogen generator. The generator separated the high-pressure air into two streams; one of waste gases vented to atmosphere, the other a flow of high purity nitrogen that was directed to the plant nitrogen system. Boeing's plant nitrogen demand is normally very low, but has huge peaks when the autoclaves are pressurized. This required the compressor to operate at very high pressures to keep as much nitrogen in system storage tanks as possible. Due to this high-pressure requirement, the compressor operated using the inlet modulation control mode, greatly reducing its efficiency when low nitrogen demands occurred. The compressor and nitrogen generator was also installed outdoors and consequently had to be run 24 hours a day and 7 days a week during cold Canadian winters to keep from freezing up.

Over the years the original system had aged and was experiencing maintenance problems and reduced capacity. This increased the quantity of expensive liquid nitrogen that had to be used to supplement the old nitrogen system. The cost of liquid nitrogen is substantial — up to 38 times the cost of producing the gas onsite. As a result, this rising liquid nitrogen consumption had the production manager's attention.

Manitoba Hydro POWER SMART

The Boeing nitrogen project qualified for an $84,500 Incentive from Manitoba Hydro.

Huge Peak Flows

The Boeing autoclaves are more than just simple curing ovens; these mammoth pressure vessels are big enough to accommodate very large aircraft parts. The largest unit is 50-feet long with a diameter of 16 feet, big enough to swallow a large transport truck. The volume of the largest of these vessels is just over 10,000 cubic feet. To maintain adequate production output levels, the operating procedures require these vessels be filled to pressures as high as 100 psi in as little as 20 minutes. This equates to peak Nitrogen flows of 3,450 cubic feet per minute, much less than the existing nitrogen generator capacity.

COMPRESSED AIR AUDIT OF THE MONTH

Nitrogen System Innovation at Boeing

Variable Speed Compressor efficiently matches the nitrogen generator demand

Large Storage

Because of this very high peak flow, Boeing had installed a large 30,000-gallon receiver to stabilize pressures and reduce the required size of the nitrogen generator. The plan was to charge this receiver to high pressure using the main screw compressor as a booster. This strategy required that all of the gases, even the waste stream vented to atmosphere, be boosted to high enough pressure to provide an adequate reserve. This pushed the specially designed screw compressor to its design limits and forced it into modulation mode, where it produced less and less air as the storage receiver filled up. Due to the characteristics of membrane style generators, this lower air flow increased the purity of the nitrogen produced, but also significantly increased the losses of the system, with the membranes venting more and more gas per unit output. In fact, much of the time the unit operated with no nitrogen output, with all the produced gas being vented directly to atmosphere.

Old System Pressure Limited

This system was at a real disadvantage in terms of Nitrogen storage. The high-pressure screw compressor was limited to an output of about 175 psi. Since the required pressure for the autoclaves was 100 psi, this left only 75 psi of differential in the large storage tank that could be used to supplement peak flows. This equates to about 20,700 cubic feet of reserve, far short of the 69,000 cubic feet that was needed for an autoclave fill to the maximum pressure. Since the old nitrogen generator could only produce about 150 cubic feet per minute of nitrogen, the shortfall had to be covered by expensive liquid nitrogen reserves.

Innovative Solution

To solve their nitrogen production shortfall, and provide increased capacity for future production expansion, Boeing approached Air Liquide, a leading supplier of industrial and medical gases, for a new solution to its nitrogen needs. Boeing challenged the company's engineering team to not only design a system with increased output capacity, but to do it at reduced energy costs.

The team successfully met the capacity requirements and greatly exceeded Boeing's energy cost reduction expectations. A new system was installed that could produce enough gas to supply Boeing's peak nitrogen demand for the foreseeable future and provide an innovative staged production process that can be shed in steps to take the nitrogen production "off peak" — saving significant utility peak demand charges.

VSD Matches the Flow

The new nitrogen system uses two 100-hp rotary screw air compressors on the front end that run at a lower pressure than the original system. One compressor uses variable speed drive technology, which allows the complete system to efficiently match the air demand of the membrane-type nitrogen generators. The other compressor, a fixed-speed unit, runs at full load at its best efficiency point and quickly unloads and turns off when demand drops off or a signal to shed load is received. The combined system gives the front end of the system the capability of automatically adjusting the output capacity to meet all levels of nitrogen generator demand, even as the nitrogen membrane bundles age.

Membrane Conversion Loss

The membrane nitrogen generators are set to maintain a purity of 98% or better and to produce about 11,600 cubic feet per hour (190 cfm) of Nitrogen. This output illustrates the typical conversion ratio of the membrane separation process at high purity levels, with the full load capacity of the front-end air compressors totaling 765 cfm. Rather than trying to push this full air output capacity to the 330 psi needed for optimum high- pressure nitrogen storage, the input air is produced at only 165 psi and the smaller flow of nitrogen at the output of the generator is fed into two small booster compressors that pump up the existing 30,000-gallon receiver tank to full pressure.

Booster Compressors charge a large 30,000 storage tank to 330 psi

COMPRESSED AIR AUDIT OF THE MONTH

Nitrogen System Innovation at Boeing

How a Nitrogen Membrane Works

Selectively permeable nitrogen membranes separate gases by the principle of selective permeation across the nitrogen membrane's wall. For nitrogen polymeric membranes, the rate of permeation of each gas is determined by its solubility in the nitrogen membrane material and the rate of diffusion through the molecular-free volume in the nitrogen membrane wall. Gases that exhibit high solubility in the nitrogen membranes, and gases that are small in molecular size, permeate faster than larger, less soluble gases.

Fast gases permeate through the nitrogen membrane wall more readily than "slow" gases, thus separating the original gas mixture into two streams. The purity of the desired streams can be adjusted by changing the operating conditions.

The ability of nitrogen membranes to separate two gases is determined by their selectivity, the ratio of permeability of the two gases. The higher the selectivity, the more efficient the separation and less energy is needed to run the system.

Boosters Add Storage Capacity

Boosting the nitrogen to pressures higher than it is used slightly increases the energy required for the smaller nitrogen flow produced by the membrane filters, but this is much less costly than producing the much larger amount of higher pressure air feeding the front end of the system. Storing the nitrogen at 330 psi in a 30,000-gallon storage receiver provides over 64,000 cubic feet of reserve capacity — enough nitrogen to fill the largest autoclave in 20 minutes.

The plant nitrogen demand has very high peak flows during autoclave filling but low nitrogen demands during normal periods. This gives the system time to catch up after filling operations, slowly recharging the storage tank over a number of hours. During this filling operation the generator is kept at 100% output capacity, its most efficient point. When the storage is full, the control system completely turns off the generator, avoiding inefficient partial load operation.

Off-Peak Savings

With current production levels, the generator needs to run only 30% of the time. This gives the system the flexibility of selectively operating at only optimum times, allowing a further cost reduction opportunity through the elimination of the nitrogen generators' peak demand from the total facility electrical demand.

Boeing's electricity bill includes both energy (kWh) and demand (kVa) components. The demand charge billed by the utility each month is calculated as the highest 15-minute peak recorded by the utility meter in the billing month. In Boeing's case, the facility peak demand occurs at a low frequency — less than 4% of the time. Because of this and because the nitrogen system was designed with large storage, has numerous periods of inactivity and controllable compressors, the production can be turned off during peak plant electrical demand, thereby saving significant demand charges. Boeing's control system uses a Manitoba Hydro supplied, specially programmed power meter that constantly monitors the total facility peak and automatically turns off one or two stages of compressor power, as required, to limit the demand contributed by the nitrogen system. This system has a bypass feature that allows full nitrogen production should storage be depleted and full production required.

	ANNUAL ENERGY (KWH)	ANNUAL ENERGY COST	DEMAND (KVA)	ANNUAL DEMAND COST	TOTAL	SAVED %
Old Design	2,150,000	$55,685	225	$19,115	$74,800	—
New Design with Demand	491,500	$12,730	195	$16,590	$29,230	61%
New Design Off Peak	491,500	$12,730	0	$0	$12,730	83%

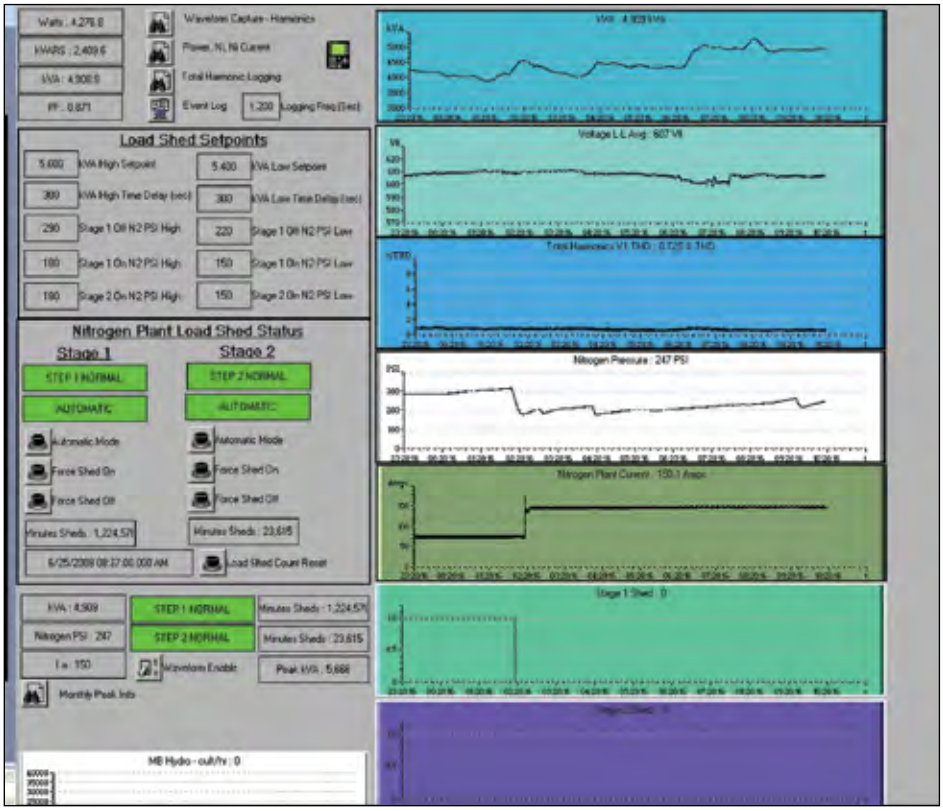
Table shows the savings for the new system and compares the charges with or without demand.

Heat Recovery

A major byproduct of the air compression process is heat. The new system is designed to recover the heat of compression to supplement building heat in the winter and further reduce costs.

Verified Results

The projected energy consumption for a system equivalent to Boeing's original nitrogen generator, but with higher capacity, was an estimated 2,150,000 kWh per year with a peak each month of 225 kW. Projected annual electrical costs would have been $76,400 including peak demand charges. The electrical operating cost of the new system, without the demand charges, has been verified at only $12,730 per year for a savings of 84%. Further liquid nitrogen savings are estimated at $30,000 per year.



This operator's screen allows Boeing to monitor the efficiency of the Manitoba Hydro designed control system.

Reliability and Efficiency

"Our new Air Liquide nitrogen system is much more reliable and cost effective than either the gas generation or liquid vaporization we previously used," says Gerry Glor, Boeing Winnipeg's Autoclave Subject Matter Expert. "And our partnership with our local utility really helped out."

This project is another example of how an innovative design team can come up with a superb solution to a production problem, in an energy efficient way. Boeing and Air Liquide's design team are commended for their innovative design and the resulting low per-unit nitrogen cost. A great example of being Power Smart®!

® Manitoba Hydro is a licensee of the Trademark and Official Mark

For more information, please contact Ron Marshall, CET, CIM, Certified Energy Manager, Industrial Systems Officer, Business Engineering Services, Manitoba Hydro, tel: 204-474-3658, email: rcmarshall@hydro.mb.ca

AIR STANDARDS

New ASME & ISO Standards for Compressed Air System Assessments

BY WAYNE PERRY, TECHNICAL DIRECTOR, KAESER COMPRESSORS

Compressors in today's market must meet a variety of standards written by a wide range of organizations throughout the world. Until recently, most standards were written to deal with safety, both mechanical and electrical, and performance of the individual components of a compressed air system. Recognition of the significant amount of power used by compressed air systems has led to a shift in standards writing over the past couple of decades. Testing standards have been or are being revised to give end users a clearer picture of how components will perform. Standards are being written to help users manage their total energy consumption. Additional standards are close to being released that will help users evaluate their compressed air systems as a "system." These newer standards can have a significant impact on plant energy consumption if properly applied.

Significant among these new standards is ASME (American Society of Mechanical Engineers) EA-4-2008 and ISO 11011. EA-4-2008 will become an ANSI (American National Standards Institute) standard when its development is complete. ISO 11011 will be an international standard. Both of these standards deal with requirements for an assessment of a compressed air system.

ASME Standard EA-4-2008

The ASME standard, EA-4-2008, is part of a suite of assessment standards that include compressed air systems, pumping systems, steam and process heat. ASME describes EA-4-2008 as follows:

> Scope: This Standard covers compressed air systems which are defined as a group of sub-systems comprised of integrated sets of components including air compressors, treatment equipment, controls, piping, pneumatic tools, pneumatically powered machinery and process applications utilizing compressed air. The objective is consistent, reliable and efficient delivery of energy to manufacturing equipment and processes.
>
> This Standard sets requirements for conducting and reporting the results of a compressed air system assessment (hereafter reference as an "assessment") that considers the entire system, from energy inputs to the work performed as the result of these inputs. An assessment complying with this Standard need not address each individual system component or subsystem within an industrial facility with equal weight; however, it must be sufficiently comprehensive to identify the major energy efficiency opportunities for improving the overall energy performance of the system. This Standard is designed to be applied primarily at industrial facilities, but many of the concepts can be used in other facilities such as those in the institutional and commercial sectors.
>
> The Standard sets requirements for: 1) organizing and conducting an assessment, 2) analyzing the data from an assessment and 3) assessment reporting and documentation.

The intent is to provide industry with a set of uniform requirements that must be met during the assessment of particular factory energy system. The United States Department of Energy (DOE) is working with the Superior Energy Performance Partnership, the ASME and industry experts in the development of these standards as part of an initiative to improve overall energy efficiency of manufacturing plants in the United States.

The Superior Energy Performance (SEP) partnership is a collaboration involving DOE, industrial companies, ANSI, U.S. Environmental Protection Agency and the National Institute of Standards and Technology. The SEP is developing a program to certify industrial facilities for energy efficiency. The program includes as a core element compliance with an energy management standard, initially ANSI MSE 2000:2008 and once it is available in 2011, ISO 50001, an international energy management standard.

The system assessment standards are consistent with the goals of both energy management standards. This SEP also plans to develop a program to certify practitioners for the application of both the energy management standard and the four system assessment standards under development. The intent is to establish a baseline of expertise required to apply these standards.

U.S. DOE and the Texas Industries of the Future are working together to pilot the certification program for industrial energy efficiency at five facilities in Texas. Feedback from testing ASME EA-4-2008 at these facilities and about 20 other sites will be used to refine the standards prior to final release as an ASME/ANSI standard.

AIR STANDARDS

ISO 10111 and ASME EA-4-2008 are being written to help users manage their total energy consumption.

ISO 11011 Standard

ISO is also developing a standard for compressed air system assessments, ISO 11011. Technical Committee (TC) 118 deals with "compressors and pneumatic tools, machines and equipment" and is in charge of developing this standard. Sub-committee (SC) 6 is tasked with this project. Development of this standard began several years ago in an effort to give users some idea of what a "competent examiner" should be doing in order to complete a proper assessment of a compressed air system. This is basically the same motivation as that of the U.S. standard. The British Compressed Air Society (BCAS) had already seen that the lack of a standard allowed people of varying degrees of expertise to promote just about any level of system examination as a compressed air system assessment. BCAS has developed a training and certification program to address this issue and has been very involved in the development of 11011.

In the fall of 2007, the Compressed Air and Gas Institute (CAGI) hosted a meeting of SC 6 in Phoenix, Arizona. This meeting was scheduled to follow a regular CAGI meeting and several CAGI members stayed to attend the SC 6 meeting. This was the first time that many of the CAGI participants had seen the draft of the ISO assessment standard. At that point, the proposed standard was only a few pages long and covered only a very limited scope. Since it was clear that the U.S. would also be developing a standard, the U.S. participants pushed to expand the scope of the ISO standard to at least get close to what was being done by the ASME team. By the end of the SC 6 meeting, the original ISO proposal was scrapped and work began on a more comprehensive draft.

A new draft of 11011 was circulated to members in 2008 for comment. Comments were gathered by CAGI in the summer of 2008 and provided to ANSI to deliver to ISO. The U.S. comments were more extensive than the draft standard and were intended to guide the ISO standard in the same direction as the ASME/ANSI standard being developed in the U.S. At a meeting of TC 118 in the fall of 2008, SC 6 adopted virtually all of the U.S. comments. A second committee draft international standard will be circulated soon for additional comments and further refinement. It is now a goal of SC 6 to develop a standard that is close enough to the U.S. standard that an assessment done to one standard will provide the same results as an assessment done to the other standard.

The U.S. standard should be in final form by mid-2009. It then has to go through the voting cycle to become an ANSI standard. The current target date for release of the standard is early in 2010. The ISO standard is still a Committee Draft and will go through another round of commenting in early 2009. These comments will be discussed at the next meeting of SC 6 in Phoenix in November of 2009. At that time, SC 6 will decide whether to keep 11011 as a Committee Draft for further rework or to release it for wider review as a Draft International Standard. The target date for release of 11011 is 2010-2011.

For more information, please contact Wayne Perry at email: wayne.perry@kaeser.com or visit www.kaeser.com

Energy Rebates

ASSIST INDUSTRIAL SUSTAINABILITY INITIATIVES

BY ROD SMITH

The CFO asks the Corporate Energy Manager, "The numbers for this energy efficiency project look too good to be true — $334,000 in annual energy savings requiring a $89,000 investment (after the energy rebate) with a simple ROI of just 3 months?" "How do we know the reduction in kWh usage, which the energy auditor has promised, will actually happen?" "Why don't we just deploy this same capital into a production project where we have more experience and confidence in the expected ROI?"

The recently hired Corporate Energy Engineer answers, "Those are the right questions to ask — we strongly believe in this opportunity for the following reasons."

1. We are currently spending $829,000 per year on energy costs to operate our compressed air system at this plant. This project will reduce those costs by 40% to $495,000 per year.
2. The project recommends known "sure thing" quick wins for the operating characteristics of this plant.
3. The Energy Conservation Program Manager from our Utility Company strongly agrees with the findings of the audit. His job is to help his industrial customers like us find real energy savings opportunities. He has endorsed this auditing firm and project and agreed to provide a:
   a. Audit Rebate of 50% of the audit costs ($10,000)
   b. Project Rebate Incentive $100,000. This reduces the project cost for our company from $189,000 to $89,000. This gives the project a simple ROI of only three months.
4. This third-party project endorsement and investment from the Utility Company *eliminates any doubt of the veracity of the energy-saving numbers.*
5. Our Corporate Sustainability Initiative will be able to implement a significant project with the following impact:
   a. Energy savings of 3,600,000 kWh per year
   b. Equivalent CO_2 Reduction of 2,567 metric tons per year
   c. Energy Savings of the equivalent kWh required to power 340 homes
   d. Equivalent CO_2 Reduction of taking 470 passenger vehicles off the road

ENERGY REBATES ASSIST INDUSTRIAL SUSTAINABILITY INITIATIVES

While the conversation outlined above is fictional, the numbers are not. They were taken from a Best Practices Case Study written by the U.S. DOE's Industrial Technologies Program (www.eere.energy.gov/industry). The California Public Utilities Commission (CPUC) and the Pacific Gas & Electric Company worked together with an auditing firm, Air Power USA (www.airpowerusa.com), and were able to help a corporation implement this important project.

The fictional conversation was created as a result of countless conversations I have with Corporate Energy Managers. These people are responsible for reducing energy costs across all the factories in their corporation. The number one challenge they talk to me about is determining whether or not they can BELIEVE THE NUMBERS. They tell me that when a third-party Rebate Incentive is involved with the project, it significantly increases their confidence in the projected energy-saving numbers.

Reduce Industrial Energy Consumption

United States manufacturing provides an easily identified and major-impact target to reduce energy consumption. There are 350,000 industrial facilities in the U.S. spending $94.4 billion per year on annual energy costs. U.S. Industry consumes 32% of the energy requirements of the U.S. — the largest consumer segment in the country. Of these energy costs, 13.5% is consumed in the form of electricity.

When you listen to the media, all you hear about is plant closings or jobs being shipped overseas. For some reason, the media doesn't like mentioning the fact that the U.S. manufacturing sector :

- Ranks as the 8th largest economy in the world
- Produces nearly 25% of the world's manufacturing output
- Employs 14 million people
- Makes the highest contribution to the economy of any sector (12% of U.S. GDP)

While facing challenges, U.S. industry has successfully implemented lean management practices and productivity is at all-time highs. The new chapter being written today is on "sustainability."

Industrial Sustainability Initiatives

Industries have consolidated over the past twenty years and we now have a higher percentage of large corporations operating hundreds of manufacturing facilities — as opposed to multitudes of owner-operated factories. A benefit of this scale is it has allowed for higher sophistication and efficiencies. Lean management has been successfully deployed in the U.S. manufacturing process culture and now "sustainability" is taking root.

"Sustainability" has become a favored investment area for corporations. The General Electric Company is a good example of a corporation using "sustainability" to shape its strategy. GE calls it "Ecomagination". Strategies described at GE's website, http://ge.ecomagination.com are:

1. Revenues to increase from ecomagination products to $25 billion per year by 2010, up from $14 billion in 2007.
2. R&D investments of $1.5 billion per year by 2010 into cleaner technology research.
3. Reduce greenhouse gas (GHG) emissions of GE's operations by improving energy efficiency. GE's GHG emissions, in 2007, were 7.02 million metric tons — a reduction of 8% from 2004. Total energy use has also been reduced by 7% since 2004. Energy Treasure Hunts have been performed at 200 GE locations resulting in a reduction of 250,000 metric tons of GHG's.
4. Reduce water use at GE facilities. In 2007, GE reduced it's water use by 2% from its 2006 reported water consumption of 12 billion gallons.

Corporate Energy Managers are the New "Conservation Heavyweights"

Driving the reduction in energy costs (and therefore GHG's) at the multiple factories lies in the hands of Corporate Energy Managers. This is one of the few hot job markets in the U.S. today. If your son/daughter is graduating in engineering, take a look at this field! Newly formed Corporate Energy Engineering teams are the new "Conservation Heavyweights" in the fight to reduce energy consumption. These small teams of one to three people can have a tremendous impact. One of the areas they focus on is compressed air and it is the Editorial Mission of Compressed Air Best Practices to help them. Air Power USA, a leading compressed air auditing firm, supplied us with an example of a corporation they worked with between 2001 and 2004.

ENERGY REBATES ASSIST INDUSTRIAL SUSTAINABILITY INITIATIVES

One Energy Manager manages the equivalent CO_2 emissions of 25,452 homes and 35,195 vehicles.

A Corporation Operating 12 plants in 11 different states with an average electric rate of $0.06/kWh. One Corporate Energy Manager is responsible for all energy costs. He decides to have his compressed air systems audited for potential energy savings opportunities at each factory and discovers that for the 12 factories:

The Total Impact of Compressed Air Systems

i. Energy cost is $16.2 million per year

ii. Energy consumption of 269.5 million kWh per year

iii. CO_2 (GHG) emissions of 192,165 metric tons per year

iv. Equivalent CO_2 emissions for 25,452 homes per year

v. Equivalent CO_2 emissions of 35,195 passenger vehicles per year

What is amazing to me is that often one person holds the key to managing the equivalent yearly CO_2 emissions of 25,452 homes and 35,195 vehicles! These people are the true "Energy Conservation Heavyweights" of this new century.

Incentive Rebates for Audits

To continue with the example of this corporation with twelve factories, the decision was made to conduct audits at all the factories over a three-year period. Each audit cost $20,000 for a total cost of $240,000 to the corporation. Third-party rebate incentives were received for five of the 12 audits for a total of $86,000. Net auditing costs were therefore $154,000. In seven of the twelve audits, however, no incentive rebate funds were received. It is to the credit of the Corporate Energy Manager and his engineering contacts at each facility that they made the investments nevertheless. In many, many situations, the corporation will not spend the money on a full-blown audit.

Incentives vary from utility to utility for audits. Tacoma Power's Compressed Air Efficiency Program will fund up to 50% of the cost of a "Demand-Side Assessment" of a system. These assessments focus on identifying air leaks and inappropriate uses of compressed air. Audit rebate programs vary state-to-state.

The U.S. DOE's Industrial Technologies Program offers Energy Assessments, which can be financed by the DOE. They ask firms to apply online. Their website says the goal of their Save Energy Now Program is to conduct 1,500 Energy Assessments between 2008 and 2012 (www.eere.energy.gov).

Incentive Rebates for Projects

The findings of an audit (or assessment) will present the factory with the actions required to reduce energy costs. In the example we've used in this article of the corporation with 12 factories, the assessment findings were as follows for the sum of the factories:

Total Annual Energy Savings Achieved with Compressed Air Systems

i. Electrical energy cost savings of $3.6 million per year representing a 22% reduction

ii. Electrical energy cost savings of 61.1 million kWh per year

iii. CO_2 (GHG) emissions reduction of 43,529 metric tons per year

iv. Equivalent CO_2 emissions reductions to power 5,765 homes per year

v. Equivalent CO_2 emissions of taking 7,972 passenger vehicles off the road per year

The corporation did receive incentive rebates for eight of the 12 projects. The numbers looked like this:

1. Project Costs: $3.5 million
2. Project Rebates: $1.2 million
3. Net Project Costs $2.3 million
4. Total Annual Energy Savings: $3.6 million
5. Simple ROI Payback: 7 months

Project incentive rebate programs vary from region to region depending upon the policies of the local utility company. Some regions are extremely active with well-funded and professionally run incentive programs, while others are completely inactive.

Tacoma Power's program offers cash incentives based on $0.12 per first-year kilowatt-hours saved up to 50% of the approved installed project cost, with a minimum of a one-year simple payback period (with incentive).

ENERGY REBATES ASSIST INDUSTRIAL SUSTAINABILITY INITIATIVES

Aid for Energy-Efficiency Incentive Programs?

I have no idea how things work in Washington D.C. or in government in general. Yet, with President-elect Obama talking about a $1 trillion plan to re-start the economy, why not get energy-rebates in the capital appropriations request line? If private and public utility companies or the U.S. DOE were given capital to encourage the Sustainability Initiatives of corporations to do more energy-efficiency projects, it seems many objectives of the new administration would be met.

1. Electrical energy conservation by U.S. industry
2. Reductions in GHG's like CO_2 in U.S. industry
3. Job Creation in auditing plants, purchasing, installing and producing energy-efficient machinery
4. Increased competitiveness of U.S. industry

Wouldn't this be a better use of taxpayer money than the financial bailouts?

Conclusion

We used an example of a 12-factory corporation in this article, which achieved significant energy savings of 22% in their compressed air systems. I have personally spoken with Corporate Energy Managers hoping to do the same in much, much, larger numbers of factories. How can we help them achieve their goals?

Perhaps it is naïve to bring up the question of how more capital be found for energy-efficiency rebates, but it seems a logical question since the funds deployed are so effective. Regions like the Northwest, the Northeast, California, Wisconsin, Minnesota, parts of the Southeast, Manitoba, Quebec and British Columbia, boast of vibrant energy-efficiency incentive programs (my apologies to anyone erroneously left out). Huge industrial regions meanwhile, like Pennsylvania, Illinois and Ohio, have insignificant rebate programs. What can be done to stimulate these regions?

What we do know is industrial rebates assist the Sustainability Initiatives of Corporations. These "Energy Conservation Heavyweights" are trying to push forward energy reduction projects in their factories. Rebates help them win the internal capital deployment debates. Rebates not only help win the ROI battle, but more importantly, provide third-party verification of the validity of the proposed energy-efficiency projects. The benefits of the projects hit many of the major priorities of the new "green economy."

For more information, contact Rod Smith, Editor, Compressed Air Best Practices™ Magazine, email: rod@airbestpractices.com, www.airbestpractices.com

Sources:

i. DOE Energy Information Administration, "2002 Energy Consumption by Manufacturers—Data Tables. Table 9.1-Enclosed Floorspace and Number of Establishment Buildings." 8 March 2005. 1 June 2007; Energy Information Administration, "2002 Energy Consumption by Manufacturers—Data Tables. Table 7.9 Expenditures for Purchased Energy Sources, 2002." 2002. 1 June 2007

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iii. DOE Industrial Technologies Program Bulletin

SEVEN SUSTAINABILITY PROJECTS FOR INDUSTRIAL ENERGY SAVINGS

Project #1: Lighting Optimization

BY THOMAS MORT, CEM

Overview

Reducing energy costs and pollution emissions involves many areas within an industrial facility. My studies have found seven key (or common) areas where low-cost practical projects can be implemented. Combined, these projects provide savings exceeding 10% of the annual energy spend of a typical industrial facility — with an average payback of less than one year.

This month's article will focus on Lighting. Optimizing the lighting system can help reduce annual energy costs by approximately 2%. Lighting is a popular energy saving project and many facilities have already begun projects in this area. Often some key points are overlooked resulting in project costs being higher than necessary. Understanding the correct requirements can significantly reduce capital costs.

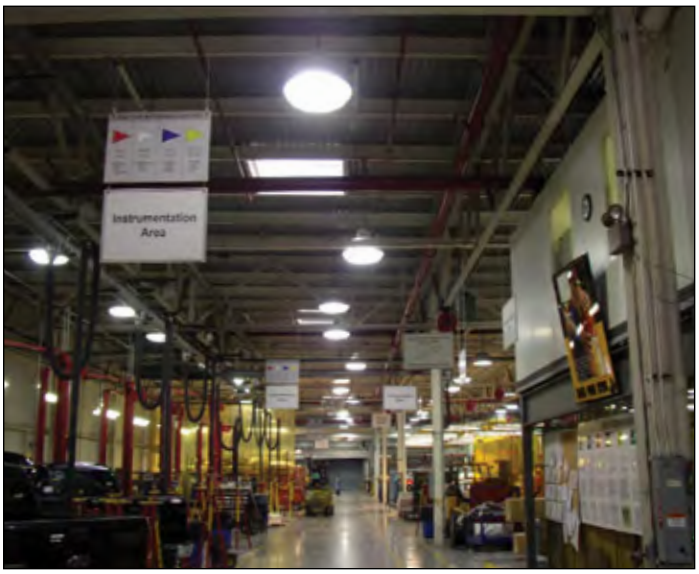
Lighting Energy Costs and Project Objectives

The factory used for this example is a facility with 149,000 sq. ft. including manufacturing floor, warehouse and office areas. The factory produces small metal and plastic injection-molded components. The annual energy spend for the facility is $1,483,000. There are 125 Metal Halide light fixtures and 355 fluorescent light fixtures. Lighting energy costs are 4.5% of the total energy spend or $67,200 per year. The objective of a lighting optimization project is to:

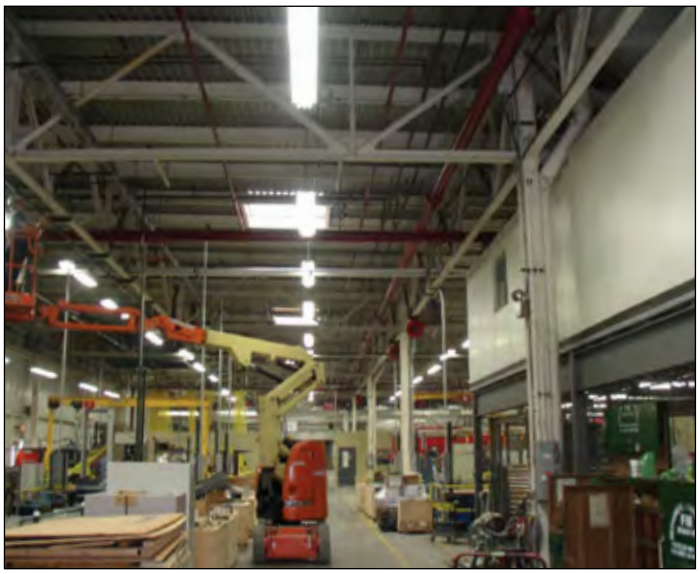
REDUCE ENERGY USAGE OF THE LIGHTING SYSTEMS BY PROVIDING THE **CORRECT AMOUNT** OF LIGHT AT THE **CORRECT TIME** WITH **EFFICIENT FIXTURES.**

7 Key Sustainability Projects

1. Lighting
2. Demand Control
3. HVAC
4. Compressed Air
5. Metering
6. Heat Recovery
7. Project Implementation and Funding



#1 400 watt metal halide light fixtures



#2 These 6 bulb T-8 Fluorescent fixtures use 50% less energy

SEVEN SUSTAINABILITY PROJECTS FOR INDUSTRIAL ENERGY SAVINGS

#3 Lights near windows are wasting energy.

#4 Often light fixtures are obstructed

Symptoms which can help identify the need for a lighting project, include:

1. Light levels are higher than necessary for the type of work being accomplished
2. Light fixtures are at a greater distance than necessary from the work area or in improper position
3. Excess lights are operating in areas without people working under the lights
4. The current light fixtures are not high efficiency

Step #1: Understand Current Lighting Status

If minimizing capital expenditure is important, then the sequential steps of a lighting project need to be followed. The first step is to understand your current lighting status. This would include a survey of the major facility areas such as the manufacturing floor and warehouses. The survey should include the following:

1. Number of fixtures
2. Bulb type and watts per bulb (example: 400 watt MH or 96 watt T12x4 ft fluorescent)
3. Number of bulbs per fixture
4. Hours per week the fixture is on without someone working under the fixture. (reference photos #5 and #9)
5. Is it possible to move the fixture closer to the work areas such as lowering it down or aligning it so the light is not blocked by an obstruction? (reference photo #4 and #8)

6. Is ambient light available from windows or skylights, which may allow the light fixture to be off during sunlight hours? (reference photos #6 and #7)

7. Is the light level reduced in non-precision work areas such as walkways and storage when compared to workstation areas?

Step #2: Determine Existing Energy Costs

The second step is to determine the value of changing the status of the existing light fixtures. For this example, I will consider the 440-watt Metal Halide light fixtures, which are commonly used, in many industrial facilities. The current energy cost of the 125 Metal Halide light fixtures is $46,563 per year.

Calculation:

# of Fixtures x watts per fixture/1,000 x hours on per week x weeks per year x $/kwh = $/year

125 x 440 watts/1,000 x 166 hours/week x 50 weeks per year x $0.102/kwh = $46,563 /year

Step #3: Determine the Correct Amount of Light:

There were 60 fixtures, which could be moved closer to the work area. By moving them closer, we were able to eliminate 20 fixtures resulting in an energy savings of $7,450.

Calculation:

# of Fixtures x watts per fixture/1,000 x hours on per week x weeks per year x $/kwh = $/year

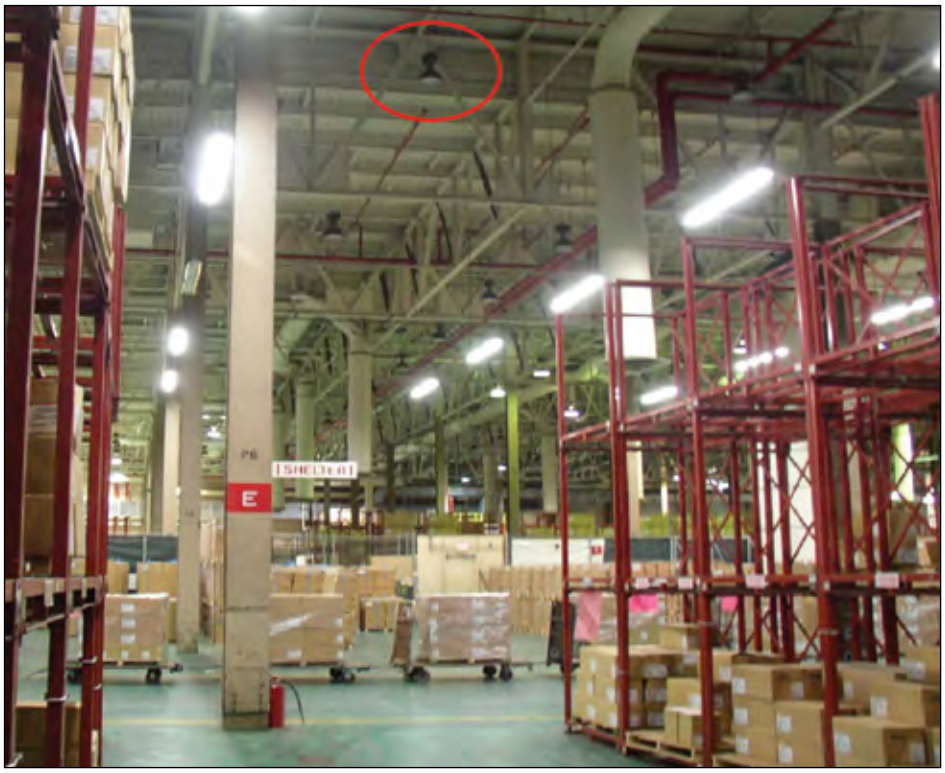
20 x 440 watts/1,000 x 166 hrs/week x 50 weeks per yr x $0.102/kwh = $7,450 /year

#5 Lights on without workers and excessive lighting in non-work areas.

#6 A simple light sensor can shut down lights when the sun is shining

SEVEN SUSTAINABILITY PROJECTS FOR INDUSTRIAL ENERGY SAVINGS

#7 These lights are turned off by sensors when the sunlight is available.



#8 Lowering the lights from the ceiling reduces energy waste.

Step #4: Use Lighting Only When Needed:

Turning off the lights when a person is not working under the lights is another opportunity. Using occupancy sensors, we found 30 lights in storage areas and warehouse aisles that could be turned off an additional 80 hours per week. The savings was $5,385.

Calculation:

# of Fixtures x watts per fixture/1,000 x hours on per week x weeks per year x $/kwh = $/year

30 x 440 watts/1,000 x 80 hours/week x 50 weeks per year x $0.102/kwh = $5,385 /year

Step #5: Use Energy-Efficient Fixtures:

Upgrading the lights to high-efficiency light fixtures will reduce the energy use per fixture by 50% and use 220 watts per fixture vs the original 440 watt. Remember we eliminated 20 lights and reduced the hours of 30 more lights. (Reference photos #1 and #2)

Calculation:

# of Fixtures x watts per fixture/1,000 x hours on per week x weeks per year x $/kwh = $/year

75 x 220 watts/1,000 x 166 hours/week x 50 weeks per year x $0.102/kwh = $13,969 /year

30 x 220 watts/1,000 x 86 hours/week x 50 weeks per year x $0.102/kwh = $2,895 /year

Total savings for high efficiency = $16,846/year

Step #6: Calculate total Energy Savings and ROI

The total energy savings per year is $29,681. This is the sum of upgrading lights to high-efficiency fixtures ($16,846 savings), using lights only when needed ($5,385) and providing the correct amount of light ($7,450).

The costs involved with generating these savings include:

A. Materials: the light fixture used to replace the 440-watt metal halide fixture is a T8 6 lamp fluorescent fixture, 32 watts per bulb. The cost is $205.00 USD including the motion sensor, the electrical cord and plug, hangars and safety chain. Calculation:
105 new fixtures x $205.00 = $21,525
for the cost of the project.

B. Labor: In-house labor was used to install the fixtures — no cost.

#9 An occupancy sensor can help determine the amount of time lights are on without people in the area.

In this lighting optimization project, annual energy savings were $29,681 with project costs of $21,525. The simple ROI on the project is 8.7 months.

Audits and Surveys

Lighting vendors are often willing to help perform your lighting surveys and provide recommendations for a higher efficiency lighting scheme. Be sure to ask them to consider occupancy rates and light intensity levels for different areas. If you receive a quotation for new fixtures I recommend that you request to have the quotation written with line item cost for each type of fixture and sets of fixtures including the current energy usage, proposed energy usage and savings for each. Review the quotation and identify the fixtures, which do not have a good payback and eliminate them from the project. Often this process of elimination will help you to reduce the overall project cost and result in an excellent ROI.

Conclusion

Reduce energy usage of the lighting systems by providing the correct amount of light at the correct time with efficient fixtures.

For more information, please contact Thomas Mort, CEM, Thomas Mort Consulting, tel: 210-858-8454, email: tcmort@savingwithenergy.com, www.savingwithenergy.com

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Utility and Energy Engineers, Utility Providers and Compressed Air Auditors share techniques on how to audit the "demand-side" of a system — including the **Pneumatic Circuits** on machines. This application knowledge allows the Magazine to recommend "**Best Practices**" for the "supply-side" of the system. For this reason we feature **air compressor, air treatment, measurement and management, pneumatics, blower and vacuum** technologies as they relate to the requirements of the monthly **Focus Industry**.

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MINIMUM SUPPLY WIRE SIZE RECOMMENDATIONS

for Compressor Packages Utilizing Variable Frequency Drives

BY MARK BEATTY, DESIGN ENGINEER, GARDNER DENVER INC.

Safety is the driving force in the determination of minimum recommended supply wire sizes for variable speed compressor packages. With this in mind, all wire size recommendations should be based on meeting, or exceeding, the minimum requirements of the National Electrical Code (NEC).

In determining the proper minimum wire size recommendation, NEC 430.122 lists the preliminary requirement to obtain the drive rated input ampacity which is listed on the drive data label, and in the appropriate drive manual. All drive input amps are added together, as applicable. Add the ancillary load amps from coils, controller, power supply and other ancillary loads to the drive input amps. Then multiply this sum by 1.25 to obtain package amperage which can be used for wire sizing, at 30 ºC ambient, per NEC Table 310.16. Please note that the 1.25 multiplier to the drive input amperage is required per NEC 430.122. Adding the ancillary load amperage total to the drive input amperage, prior to performing the 1.25 multiplier calculation, serves to add a small amount of increased safety factor for wire sizing. An example of this procedure is demonstrated as follows:

- For a 460V, 40 kW compressor, the drive input amps are listed as 90A
- The remaining ancillary loads total 10
- 90A + 10A = 100A x 1.25 = 125A at 30 ºC ambient (Package Amps)

MINIMUM SUPPLY WIRE SIZE RECOMMENDATIONS FOR COMPRESSOR PACKAGES UTILIZING VARIABLE FREQUENCY DRIVES

Based on the example above, if a wire run length of 100 feet of 75 ºC copper wire is used and all terminal connection points are rated for a minimum of 75 ºC, then copper wire size number 1 AWG can be used for this application as it is rated for 130A at 30 ºC ambient which meets the minimum package conductor amperage requirement of 125A. Keep in mind that the length of the wire run to the compressor is important as it directly affects voltage drop.

Most drive applications utilize 40 ºC or 45 ºC for ambient temperature conditions. These conditions require conductor ampacity correction(s) to allow for the higher temperatures. The NEC requires that conductor sizes for use in other than 30 ºC ambient temperature be determined by using the appropriate multiplier listed at the bottom section of NEC Table 310.16, and selecting the conductor size that has sufficient ampacity, after correction(s), to meet the load requirements. Conductor ampacity is to be corrected, not "Package Amps." An example of this procedure, utilizing the example shown above, is as follows:

- The 1 AWG copper conductors referenced, above, are rated for 130 amperes based on an ambient temperature of 30 ºC and a conductor temperature rating of 75 ºC.
- For 40 ºC ambient conditions, the 75 ºC conductor ampacity correction factor is 0.88 resulting in the 1 AWG copper conductor ampacity being corrected from 130 amperes at 30 ºC to 114.4 (130 x .88) amperes at 40 ºC ambient. Number 1 AWG wire is not sufficient for this application at 40 ºC because the corrected conductor ampacity is less than the required minimum of 125 amperes.
- For 45 ºC ambient conditions, the 75 ºC conductor ampacity correction factor is 0.82 resulting in the 1 AWG copper conductor ampacity being corrected from 130 amperes at 30 ºC to 106.6 (130 x .82) amperes at 45 ºC ambient. Number 1 AWG wire is not sufficient for this application at 45 ºC because the corrected conductor ampacity is less than the required minimum of 125 amperes.

As stated above, the corrected number 1 AWG conductor ampacity is insufficient for use with this application in 40 or 45 ºC ambient conditions. Utilizing the appropriate correction factors, the 40 ºC application would require a minimum copper conductor size of 1/0, and the 45 ºC application would require a minimum copper conductor size of 2/0 to meet minimum NEC requirements.

Last but not least, NEC 310.15 (B) (2) (a), and the associated Table, reference additional conductor ampacity correction multipliers that must be applied if more than three current carrying conductors are to be installed in a single conduit (raceway). An example of this procedure is demonstrated as follows:

- Assume that a 460V, 135 kW compressor has package amperage of 265A for wire sizing.
- The minimum recommended 75 ºC copper supply wire size for six conductors (two parallel sets) in a single conduit is 3/0 AWG for 40 ºC ambient conditions. Based on the proper copper conductor ampacity corrections for ambient temperature and six conductors (two parallel sets) in a single conduit, the corrected combined ampacity of both sets of the 3/0 AWG copper conductors is 281.6A which meets or exceeds the wire sizing requirements (200A x 2 = 400A x 0.88 = 352A x 0.8 = 281.6 corrected conductor ampacity).
- The minimum recommended 75 ºC copper wire size for six conductors (two parallel sets) is 4/0 AWG for 45 ºC ambient conditions. Based on the proper copper conductor ampacity corrections for ambient temperature and six conductors (two parallel sets) in a single conduit, the corrected combined ampacity of both sets of the 4/0 AWG copper conductors is 301.76A which meets or exceeds the wire sizing requirements (230A x 2 = 460A x 0.82 = 377.2A x 0.8 = 301.76 corrected conductor ampacity).

"Safety is the driving force in the determination of minimum recommended supply wire sizes for variable speed compressor packages."

Again, the minimum recommended supply wire sizes should be determined based on personnel and equipment safety being of the utmost concern. The final decision on the proper supply wire size should be reached by a qualified electrical professional, after taking into account all installation site-specific variables such as the type of wire used, temperature rating of lowest rated terminal connection point, length of the required wire run, actual supply voltage, maximum permitted voltage drop, ambient temperature, etcetera. As you can plainly see, there are many variables to be taken into account to ensure a minimum level of personnel and equipment safety. Everyone benefits when safety is the priority!

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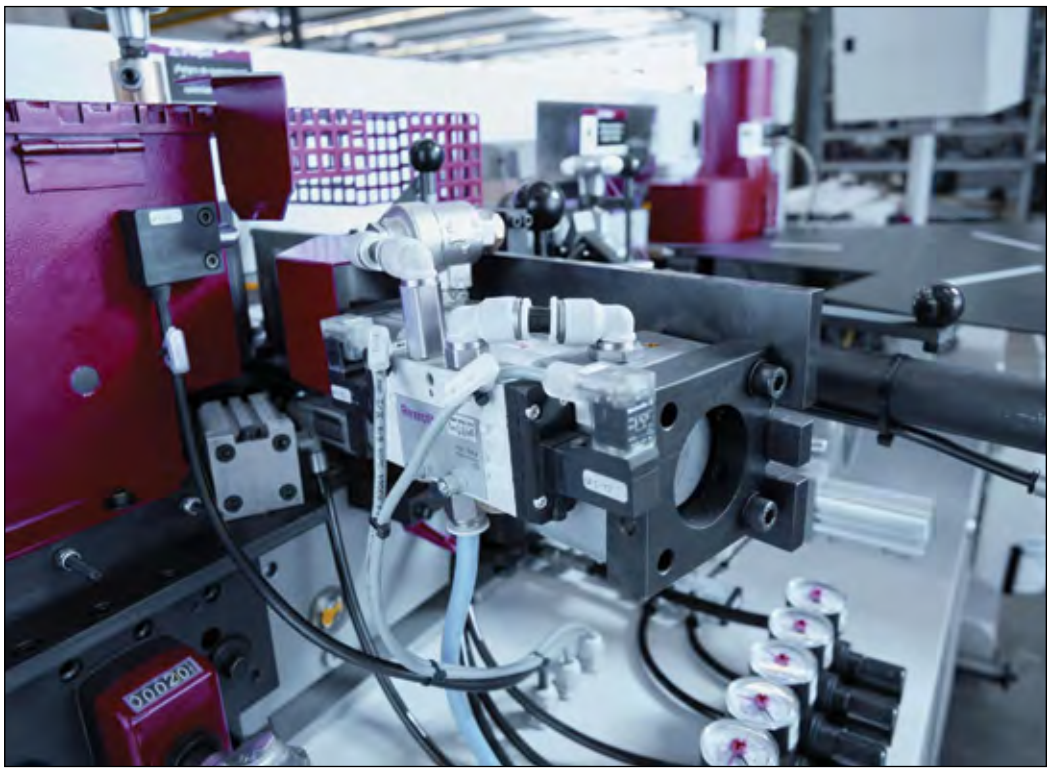
THE PNEUMATIC ADVANTAGE

Pneumatics Bring Precision and Reliability to Furniture Industry Specialist

BY MARKUS HEIDEMANN AND JÖRG SCHRÖDER

Pneumatic system overhaul for furniture machining center yields high-precision results for a perfect, polished finish.

Office desktops, shelving, countertops — furniture derived from timber planks is a part of everyday life. In order to ensure that the roughly sawn edges of regrown, raw material are suitable for furniture manufacturing, the edges need to be banded in machining centers. At IMA Klessmann of Lübbecke in Germany, Advantage 60/70 machines process laminate between eight and 60mm thick using thin, thick or solid wood edges to produce finished furniture elements. These decorative edges are then attached to the milled cut edge of the timber. The first stage of processing entails fixing a separating agent to the decorative surface of the laminate. A bonding milling unit mills the edge in both longitudinal and transverse directions, in order to remove even the minutest grooves from the edge. This results in a smooth adhesive surface for fixing the decorative edge.



In the multifunctional unit valves and cylinders are supplied assembled as a complete unit and fitted with Plug-&-Work-piping.

THE PNEUMATIC ADVANTAGE

The HF04 valve support system is ideal for applications requiring a high throughput rate in a confined space.

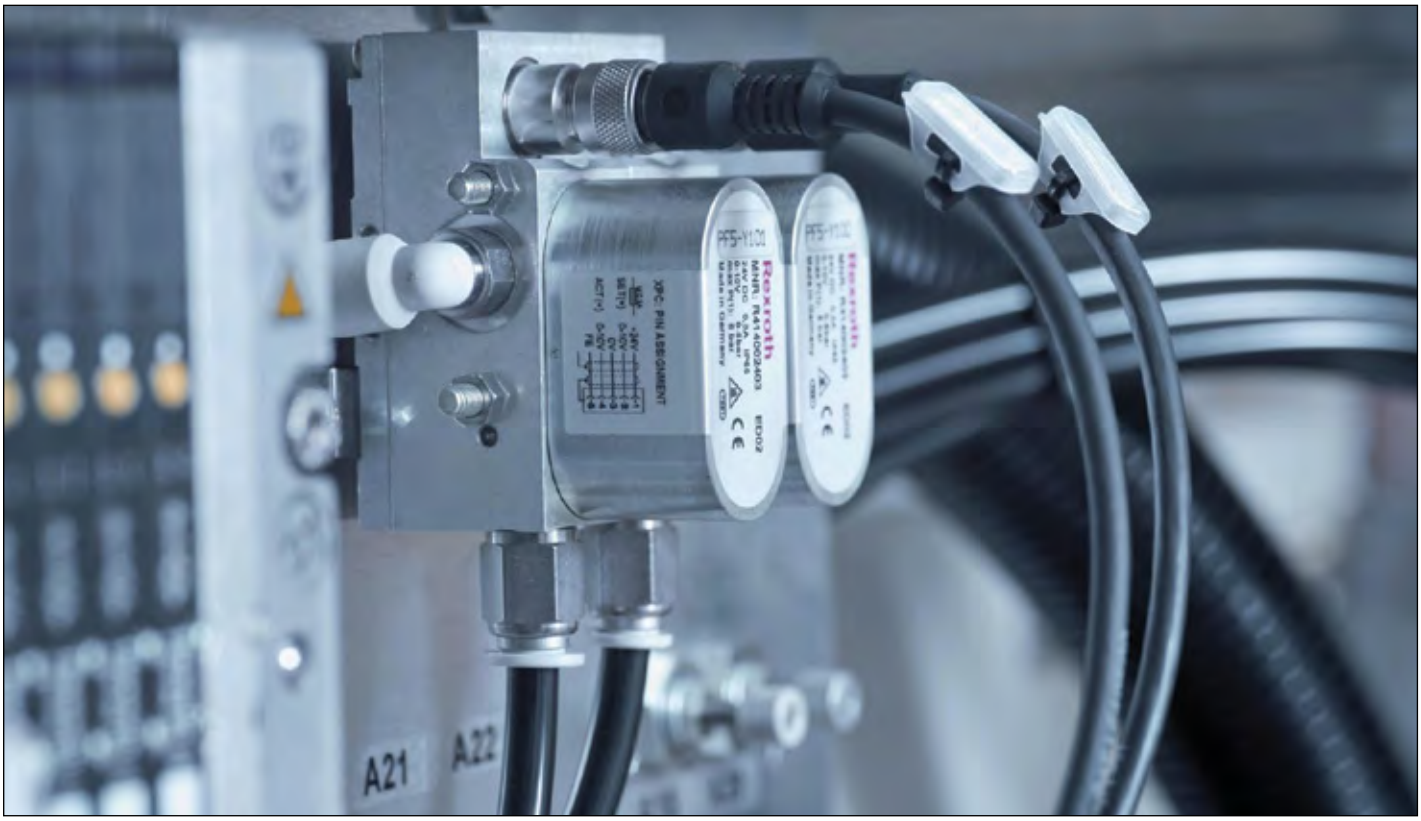
The right feed

Advantage 60/70 machines work with a feed of 16 meters (52 feet) per minute. Even at high speed, the workpiece and decorative strips are fed accurately to the bonding unit. The workpiece is heated up and travels past the adhesive spreading roller, which releases the hot-melt adhesive at the edge. Holding rollers then press the strip firmly against the wooden edge. Heating up the edge prevents the adhesive from cooling too quickly, thus helping to achieve optimum adhesion. Since the quantity and type of adhesive required varies based on whether the strip is made of plastic or solid wood, the Advantage 60/70 has a quick-lock system, permitting a swift change of adhesive container. A pneumatically controlled bayonet closure forms a secure interface between glue and adhesive mechanism.

A pneumatically driven knife removes any excess material on the edges. With a clean cut, any projecting length on the front and rear edges, or cover strips of the workpiece, is then reworked with precision. Rexroth PRA cylinders are used for the workpiece feed, controlled by an HF04 valve unit. For the knife, Rexroth supplies valves from the TC15 Series and 523 Series cylinders, assembled as a complete unit and fitted with Plug-&-Work-piping. "By using pre-assembled power units we save valuable assembly time," reports Jürgen Kleine-Beek, Developer at IMA Klessmann. "Apart from this we are also able to reduce our logistics costs. We rely on a strong partner to supply us with reliable components."

Decisive benefits

The multi-functional power unit of the Advantage 60/70 from IMA, offers the customer decisive benefits. The upper and lower edges of the workpiece are finely milled and the front and rear edges copy milled in a single work process. This complete machining phase is undertaken using only two motors. An ED02 electropneumatic pressure control valve from Rexroth ensures that the unit is fed gently towards the



The compact design of the ED02 pressure control saves valuable space.

workpiece. This pressure control valve also permits a swift response when the command value changes. The machine control specifies an electrical command value, which the ED02 then converts into a pneumatic pressure.

"Using the compact ED02 electropneumatic pressure control valve enabled us to save the customer installation space. Where formerly four individual valves and various pressure controllers were used, you will now find a single ED02," reports Markus Heidemann from Ingenieurbüro Heidemann. "Together with Rexroth we have overhauled the pneumatic control sequence," adds Kleine-Beek. "Applying the new products from Rexroth was particularly interesting for us. They are compact in design and we were also impressed with respect to their power density."

The compressed air for the complete pneumatic system in the machine is provided by an AS3 conditioning unit. "We are intentionally using lots of pneumatic components in the machines, as they offer an economical, robust and reliable option for the drives," explains Kleine-Beek.

The perfect finish

In order to be able to machine different edges, the Advantage 60/70 is equipped with a swift exchange system. The Series CCI compact cylinder is used for controlling this power unit. The workpiece is transported by an eLINE-ball bushing guide. This is ideal for economic assembly as it is self-supporting. Thick and thin edges are reworked using a flat scraper. The perfect finish is achieved for all machined workpieces using a polishing machine, which gives the edges a final clean and polish — for a perfect piece of furniture.

For more information, contact Markus Heidemann and Jörg Schröder
Bosch Rexroth Corporation – Pneumatics, www.boschrexroth-us.com
Tel: 1-800-REXROTH (1-800-739-7684), email: info@boschrexroth-us.com

PERSONAL PRODUCTIVITY

Is Afternoon Fatigue Influencing Your Job Performance?

The Explanation and Some Solutions

BY DR. DAVID TANTON

Millions of Americans have very productive mornings; catching up on e-mails and voicemails, attending meetings and completing projects left over from the day before. Then the clock strikes noon and they head to lunch. Following lunch, they return to their offices, often feeling tired, drained and less-than-productive. While the morning was filled with efficiency, now energy is plummeting fast and the afternoon slump has set in!

Many things can contribute to afternoon fatigue, but feeling alert can be critical to both your job performance and your job security. Let's evaluate what causes the afternoon slump and start to make it a thing of the past. Following is the formula that will make the difference.

- What you eat for lunch is important. Following a heavy meal especially, an increased amount of energy will be diverted to the stomach for digestion, leaving less energy for your brain.
- The combination of foods you consume is also important. For example, meat and starches in combination are slow to digest. Then, eating fruit, or drinking fruit juice with a meal, will greatly increase the digestion time as well. Thus, fruit or fruit juice should be consumed at least 30 minutes before or 2½ hours following a meal. Eating a lighter lunch and chewing thoroughly speeds up digestion.
- If you are finding it difficult to stay awake at times and are taking medications that could very well be your problem. Of the 200 most prescribed medications, 175 (87.5%) listed "fatigue" or "drowsiness" as possible side effects!
- Low thyroid (hypothyroid), low blood sugar (hypoglycemia), dehydration or insufficient oxygen can all influence your mental capacity and your ability to remain alert. The hypothyroid condition is surprisingly common, as well as the most often misdiagnosed, or improperly treated condition. Your thyroid is rather like your I.Q. There is a range that is considered normal, although borderline-low is still considered as acceptable by most doctors. Your thyroid function influences how efficiently food is metabolized and oxygen is utilized. The most common symptoms associated with a hypothyroid condition are fatigue, depression and inability to concentrate — all critical to our performance.
- Anemia, caused by insufficient red blood cells, is one well-known contributor to fatigue. Anemia can result from a low thyroid condition, as well as a deficiency of vitamin B12 or folic acid. And of the 180 most commonly prescribed medications, 61% depleted folic acid, 70% depleted vitamin B12 and the majority actually depleted both! Taking a high-potency vitamin B-complex such as B-100, along with 50 mg of Coenzyme Q10, twice daily, (upon rising and at noon), can help maintain your energy level and prevent fatigue throughout the day.

Getting Adequate Sleep Is Critical

Insufficient sleep is a concern for every employee, as it can lead to industrial accidents or work-related errors. Adequate sleep plays an important part regarding efficient retention and recall. During sleep, the demand for our resources is greatly reduced, allowing healing and regeneration to take place. Thus we will be healthier and more productive if we get adequate sleep. Surprising as it might seem, you won't accomplish more by sleeping fewer hours, as you will actually be less productive during the day.

The influence sleep deprivation might have on you as an employee could vary, depending on your particular profession and position. For example, it is especially critical for any managers, whose communication skills are important in order to adequately motivate employees and help maintain their job satisfaction. Employee turnover and re-training is something every company should attempt to keep to a minimum.

Then, if insomnia is a problem, try avoiding diet sodas containing aspartame (NutraSweet™ or Equal™), as they can block the formation of melatonin and serotonin, contributing to both insomnia and depression. Some people drink alcohol to relax in the evening. Although they may fall asleep easily, they don't stay asleep, and normally wake up between 2 and 4 a.m. Excessive alcohol or drugs, such as Valium™ or SSRI antidepressants such as Prozac, completely inhibit the

PERSONAL PRODUCTIVITY

important REM sleep, when the most regeneration takes place. Some people claim that tobacco calms them down, although nicotine actually mimics the effects of adrenaline, promoting insomnia. Hunger can definitely disturb your restorative sleep, (especially a concern with hypoglycemics). A protein snack before retiring should help. Taking 6 mg. of melatonin before going to sleep increases your chances of getting a good night's rest.

> "Many things can contribute to afternoon fatigue, but feeling alert can be critical to both your job performance and your job security."

Attitude Makes All The Difference!

Your attitude plays an important role in developing job satisfaction. Nothing contributes to drowsiness faster than boredom, which can often be eliminated with a minor attitude adjustment. You might consider striving to become Employee of the Month — every single month — and avoid stress whenever possible. If you feel you are in hyper-drive, and thus have difficulty focusing, try taking the amino acid L-theanine, made from green tea. It stimulates the calming amino acid GABA in the brain, and produces the more mentally productive alpha waves, which helps you stay focused. L-theanine is especially beneficial for a Type-A individual, or anyone working at a stressful job.

It might help to pretend that you are a silent partner, as your motivation and performance plays an important part in your company's success and your job security. Always have a cheerful up-beat attitude, and be a team player. It's amazing how rapidly time passes when you develop the proper attitude. If you are required to spend time away from home, you might as well make sure it's quality time.

This is the kind of individual every manager is looking for. And when it comes to advancement, they are the first to be considered and the last the company would want to lose when laying off employees due to downsizing.

By incorporating these recommendations, your afternoons can be every bit as productive as your mornings and rather than "crashing" after work, you can finally spend quality time with your friends or family as well.

About the Author:

Dr. David Tanton graduated with honors from Clayton College of Natural Healing with a Ph.D. in Holistic Nutrition and is the founder and research director or the Soaring Heights Longevity Research Center. He is the author of the award-winning book, "A Drug-Free Approach to Healthcare" as well as, "Antidepressants, Antipsychotics and Stimulants — Dangerous Drugs on Trial." At the age of 74, Dr. Tanton is 100% drug free and is in optimal health. He believes that drugs are seldom necessary and can normally be easily withdrawn. For more information, visit www.DrTanton.com or e-mail longevitycntr@peoplepc.com.

RESOURCES FOR ENERGY ENGINEERS

PRODUCT PICKS

New Regulators use 80% less air

Precise pressure control and pressure adjustment can be critical factors when working with either pressure fed fluids, air pilot regulator supply or during test and inspection applications. SMC announces a new, improved, range of direct operated precision regulators, Series ARP 20/30/40. Series ARP now offers several advantages over previous SMC models including a decrease in air consumption by up to 80% compared to previous models Further benefits of this new modular regulator range include digital pressure gauges fitted as standard and reverse flow functionality.

SMC USA
Tel: 1-800-SMC-SMC1
www.smcusa.com

Blowers with Integrated Controller

Kaeser has introduced the new DB Blower Series of Com-paK Plus™ Packages. The new Omega Control Basic™ integrates motor starters and instrumentation, which reduces installation cost and provides assurance that the package will run the first time, every time. Available from 7.5 to 60 hp with capacities up to 812 cfm at 3 psig, the DB Series features an efficient tri-lobe blower design and a selection between a reduced voltage starter or a frequency converter.

Kaeser Compressors
Tel: 800-777-7873
www.kaeser.com/omega

RESOURCES FOR ENERGY ENGINEERS

PRODUCT PICKS

Verify Energy Savings

Airleader Professional is a German-engineered multi-master air compressor control and monitoring system. With over 6,000 installations, the Web-based Airleader provides permanent monitoring and ongoing control for compressor systems. This includes automated system alerts via text message, e-mail or online reporting. The built-in monitoring system allows compressor systems to be managed and monitored from your desk.

Airleader is an excellent tool to verify energy savings realized during improvement projects. Variables measured include the KPI Key Performance Index (kWh/100 CF) of each compressor, the overall compressor system performance and the internal memory holds years of data.

Airleader
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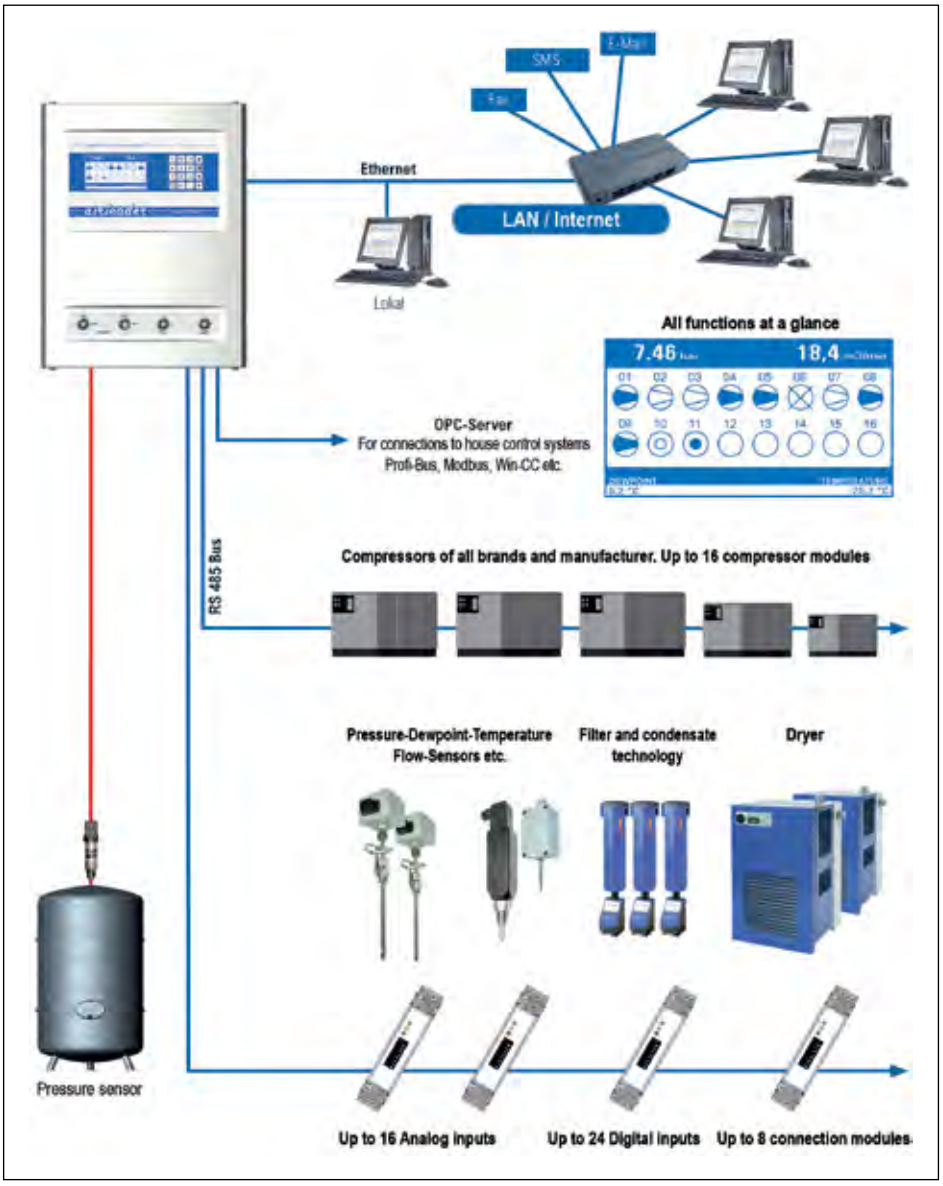

PRODUCT PICKS

Re-engineered 15–40 HP VSD Compressors

Atlas Copco has re-engineered its range of small GA compressors, 15–40 hp GA+/GA VSD, in order to provide greater energy savings for workshops and industries through a combination of world-class Free Air Delivery (FAD), increased efficiency, a smaller compressor footprint and lower noise levels.

FAD has increased from 7–17% over previous GA models and from 9–24% for the GA VSD. The Atlas Copco 15–40 hp GA+ VSD models announce a Specific Energy Requirement (SER) improvement of 3–11% over previous models and the improvement spans 11–13% for the GA VSD. A user-friendly, new generation controller operates every model to ensure maximum energy savings and correct servicing intervals. Energy consumption can be reduced even further in the full feature version by integrating the dryer in the unit.

Atlas Copco
www.atlascopco.com.

TRAINING CALENDAR

TITLE	SPONSOR	LOCATION	DATE	INFORMATION
Fundamentals of Compressed Air	Compressed Air Challenge®	Omaha, NE	3/24/2009	www.compressedairchallenge.org
Fundamentals of Compressed Air	Compressed Air Challenge®	Omaha, NE	3/25/2009	www.compressedairchallenge.org

Editor's Note: If you conduct compressed air system training and would like to post it in this area, please email your info to rod@airbestpractices.com

Wall Street Watch

BY COMPRESSED AIR BEST PRACTICES™

The intent of this column is to provide industry watchers with publicly held information, on publicly held companies involved with the sub-industry of compressed air. It is not the intent of the column to provide any opinions or recommendations related to stock valuations. All information gathered in this column was on December 14, 2008.

DECEMBER 14, 2008 PRICE PERFORMANCE	SYMBOL	LAST PRICE	1 MONTH	6 MONTHS	12 MONTHS
Parker-Hannifin	PH	$37.03	3.0%	-52.9%	-53.0%
Ingersoll Rand	IR	$15.63	3.4%	-60.7%	-68.7%
Gardner Denver	GDI	$24.42	8.7%	-54.2%	-27.9%
United Technologies	UTX	$48.82	-2.8%	-28.8%	-36.4%
Donaldson	DCI	$31.63	10.1%	-36.5%	-30.3%
EnPro Industries	NPO	$19.96	13.7%	-48.9%	-34.8%
SPX Corp	SPW	$34.32	3.4%	-75.4%	-67.6%

CHARLOTTE, NC — October 29, 2008 — SPX Corporation (NYSE:SPW) today reported results for the third quarter ended September 27, 2008:

Revenues increased 28.8% to $1.51 billion from $1.17 billion in the year-ago quarter. Organic revenue growth* was 6.5%, while completed acquisitions and the impact of currency fluctuations increased reported revenues by 19.7% and 2.6%, respectively.

Segment income and margins were $208.8 million and 13.8%, compared with $166.7 million and 14.2% in the year-ago quarter. Excluding the dilutive impact of the APV acquisition, segment margins improved 120 basis points.

Diluted net income per share from continuing operations was $2.01, compared with $1.74 in the year-ago quarter.

Net cash from continuing operations was $103.8 million, compared with $48.3 million in the year-ago quarter. The increase in cash flow was due primarily to increased operating income.

Chris Kearney, Chairman, President and CEO said, "SPX's third-quarter performance marked another period of solid revenue and earnings growth for our company, despite facing the most challenging economic environment in recent history. Our adjusted earnings per share of $1.66 represents a 19% increase over the same period last year, and we had strong revenue growth of 29% during the quarter.

"At this time, we are narrowing our full year earnings guidance to a range of $6.40 to $6.50 per share. This is necessary primarily from the impact the recent rapid strengthening of the U.S. dollar against many of the foreign currencies in which we conduct business is expected to have on our fourth quarter results. Although we're unable to predict what impact the current global financial crisis will ultimately have on our customers, we are confident in the strategic direction we embarked on four years ago and we maintain our conservative approach to capital allocation. We believe we are well positioned to remain competitive and resilient during these uncertain times," Kearney added.

Flow Technology

Revenues for the third quarter of 2008 were $493.0 million compared to $256.3 million in the third quarter of 2007, an increase of $236.7 million, or 92.4%. The increase was due primarily to the fourth quarter 2007 acquisition of APV, which contributed $211.5 million of revenues during the quarter. Additionally, organic revenue growth* was 8.3% in the quarter, driven primarily by strong sales in the power, oil and gas and dehydration markets. The impact of currency fluctuations increased revenues by 1.0% from the year-ago quarter. Segment income was $55.8 million, or 11.3% of revenues, in the third quarter of 2008 compared to $44.2 million, or 17.2% of revenues, in the third quarter of 2007. Segment income was favorably impacted by organic growth and operating profit from the APV acquisition. Segment margins declined primarily due to the significantly lower margins at APV.

WALL STREET WATCH

> "Despite the challenging and uncertain economic environment, our core businesses continue to perform well and I am optimistic about the future of the Company."

Gardner Denver, Inc. (NYSE:GDI) announced that revenues and net income for the three months ended September 30, 2008 were $480.3 million and $34.6 million, respectively. For the nine-month period of 2008, revenues and net income were $1.5 billion and $135.1 million, respectively.

Operating income for the three and nine-month periods ending September 30, 2008 was $55.5 million and $205 million, respectively. Diluted earnings per share ("DEPS") for the three months ended September 30, 2008 were $0.65 and $2.52 for the nine-month period of 2008.

CEO's Comments Regarding Results

"I am very pleased with the performance of the Gardner Denver team in the third quarter of 2008 and the operational improvements we have begun to achieve," said Barry L. Pennypacker, Gardner Denver's President and Chief Executive Officer. "Despite the challenging and uncertain economic environment, our core businesses continue to perform well and I am optimistic about the future of the Company. Many milestones were reached during the quarter, including the announcement of the CompAir transaction, one of the largest and most strategic acquisitions in the Company's history. In addition, we negotiated and closed new $650 million multicurrency senior secured loan facilities, which were oversubscribed despite an incredibly difficult credit environment.

"While the Gardner Denver team is progressing on our externally-focused objectives, we are also executing on our planned operational improvements," said Mr. Pennypacker. "The Company's lean transformation continues to build momentum, with most of our plants throughout the world implementing programs to improve operational efficiencies. An implementation of lean programs typically results in near-term pressure on gross profit and operating margins as production levels, lead times and inventory are reduced. However, in the long-term, lean initiatives are expected to provide greater benefits through lead-time reduction and operating margin improvements. Typically, the immediate benefit of lean efforts is realized in incremental cash provided by operating activities as inventory decreases. In the third quarter, Gardner Denver's inventory turnover improved to 5.6 times, the highest recorded amount in the Company's history, and inventory reductions contributed approximately $14 million to the Company's record cash provided by operating activities in the third quarter of 2008, which exceeded $87 million. For the nine-month period of 2008, cash provided from operating activities exceeded $204 million, compared to $127 million in the same period of 2007. I am very proud of the efforts of our employees throughout the world and look forward to achieving our next milestones."

"I am also very excited about the opportunities that will be created by the integration of CompAir with Gardner Denver's existing compressor operations throughout the world. The combined businesses will significantly enhance our channels of distribution to serve the global market. Our integration team has already begun to implement their plans, with the goal of blending the complementary product lines and geographic reach of CompAir and Gardner Denver in order to take advantage of future growth opportunities for our products, services and employees."

Commenting on the worldwide demand environment, Mr. Pennypacker continued, "It is challenging to project industrial product demand on a global basis in the current economic environment. At present, demand remains strong in end market segments in Asia and Eastern Europe, while growth has stalled in North America and slowed considerably in the last few weeks of September in Western Europe. Our shorter lead-time products that are more susceptible to swings in the economy, such as those that serve light industry and Class 8 trucks, are experiencing challenging demand environments, whereas demand for products for medical applications and longer lead-time products for process applications, such as energy and environmental, have remained resilient. Worldwide economic difficulties and the financial crisis, however, have clouded our visibility into many of our key end market segments and we remain cautious in our outlook for 2009.

"For the three months ended September 30, 2008, compared to the same period of 2007, revenues increased 5%, reflecting the favorable impact of foreign currency exchange rates and moderate growth in Europe and Asia, offset by lower shipments of petroleum pumps," said Mr. Pennypacker. "Gross profit as a percentage of revenues ('gross margin') declined in the third quarter of 2008, when compared to the third quarter of 2007, primarily as a result of decreased shipments of petroleum pumps and the pursuit of lean initiatives. Operating income as a percentage of revenues declined year-over-year as a result of the lower gross margin and $14.7 million of expenses relating to profit improvement initiatives, non-recurring expenses, and mark-to-market currency adjustments.

"Our Compressor and Vacuum Products segment revenues grew by 7% in the third quarter of 2008, when compared to the same period of 2007, due to favorable changes in foreign currency exchange rates and strong shipments in Europe and Asia. Orders increased 1% in the three months ended September 30, 2008, when compared with the same period of 2007, reflecting favorable changes in foreign currency exchange rates and good demand for original equipment manufacturer ('OEM') applications on a global basis, which was almost entirely offset by lower demand for low-pressure and vacuum applications in Europe. The third quarter of 2007 also included a significant order for an engineered package to be used in a mining application that did not recur in 2008.

"Adjusted Operating Income for the Compressor and Vacuum Products segment in the third quarter of 2008 was $48.9 million and segment Adjusted Operating Income as a percentage of revenues was 12.7%," said Mr. Pennypacker. "Segment operating income (1), as reported under GAAP, for the Compressor and Vacuum Products segment for the three months ended September 30, 2008 was $35.2 million and segment operating income as a percentage of revenues (segment operating margin (1)) declined to 9.1%, compared to 11.6% in the same quarter of last year. The decline in segment operating margin was the result of costs associated with profit improvement initiatives, non-recurring expenses, and mark-to-market currency adjustments, which reduced segment operating income by $13.7 million and segment operating margin by 3.6 percentage points.

"Worldwide economic difficulties and the financial crisis, however, have clouded our visibility into many of our key end market segments and we remain cautious in our outlook for 2009."

WALL STREET WATCH

Outlook

"The Company expects orders for its compressor and vacuum products to slow in the fourth quarter of 2008, driven by declining demand in the United States and Europe, partially offset by continued growth in Asia. We expect to see stable demand through the end of the year for OEM, marine, locomotive and process applications. Demand is expected to continue to decline for our lower horsepower and general industrial products. We anticipate revenue growth to slow in the fourth quarter of 2008 as a result of this order outlook, partially offset by a reduction in backlog as operational improvements are achieved," said Mr. Pennypacker.

"Demand surged in the third quarter for our petroleum pumps and our production capacity for most of these products is sold out into the first quarter of 2009. To date, demand for new rigs has not appeared to slow, given the need for upgrades to improve efficiencies. In addition, in the third quarter we experienced improved demand for well servicing pumps, as excess capacity is absorbed in North America. However, recent volatility in oil and natural gas prices has caused dramatic shifts in the capital expenditure expectations of certain oil and gas exploration and production companies, which may result in a lower average rig count in North America in 2009.

"We expect to see stable demand through the end of the year for OEM, marine, locomotive and process applications."

Third Quarter Results

Revenues increased $23.1 million (5%) to $480.3 million for the three months ended September 30, 2008, compared to the same period of 2007. Compressor and Vacuum Products segment revenues increased 7% for the three-month period of 2008, compared to the previous year, driven by favorable changes in foreign currency exchange rates and organic growth in most product lines. Fluid Transfer Products segment revenues decreased 3% for the three months ended September 30, 2008, compared to the same period of 2007, primarily resulting from decreased petroleum pump volume, partially offset by incremental sales of all other product lines and favorable changes in foreign currency exchange rates (see "Selected Financial Data Schedule").

Gross profit increased $1.2 million (1%) to $150.4 million for the three months ended September 30, 2008, compared to the same period of 2007, as a result of the higher revenue. Gross profit as a percentage of revenues declined to 31.3% in the three-month period of 2008, from 32.6% in the same period of 2007, due primarily to product mix, partially offset by operational improvements and leveraging fixed and semi-fixed costs over additional sales volume.

Net income for the three months ended September 30, 2008 decreased $19.0 million (35%) to $34.6 million, compared to $53.7 million in same period of 2007, due primarily to costs associated with profit improvement initiatives, non-recurring expenses, and mark-to-market currency adjustments incurred in the third quarter of 2008 and the increase in the effective tax rate discussed previously.

Nine-Month Results

Revenues for the nine-month period of 2008 increased $135.6 million (10 %) to $1.5 billion, compared to $1.4 billion in the same period of 2007. This increase resulted from favorable changes in foreign currency exchange rates and organic growth.

Gross profit increased $27.6 million (6%) to $479.6 million in the nine months ended September 30, 2008, compared to 2007, primarily as a result of higher revenue. Gross profit as a percentage of revenues decreased to 32.1% in the first nine months of 2008, compared with 33.3% in 2007, due primarily to product mix, partially offset by operational improvements and leveraging fixed and semi-fixed costs over additional sales volume (see "Selected Financial Data Schedule").

As a result of the costs associated with profit improvement initiatives, non-recurring expenses and mark-to-market currency adjustments in 2008 and the increase in the effective tax rate discussed previously, net income decreased $6.2 million (4%) to $135.1 million for the nine months ended September 30, 2008, compared to $141.2 million for the same period of 2007.

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Advertising & Editorial: Rod Smith
rod@airbestpractices.com
Tel: 251-680-9154

Subscriptions & Administration: Patricia Smith
patricia@airbestpractices.com
Tel: 251-510-2598
Fax: 412-831-3091

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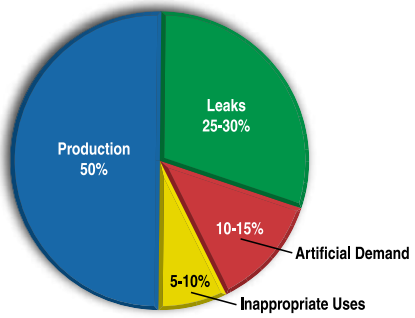

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