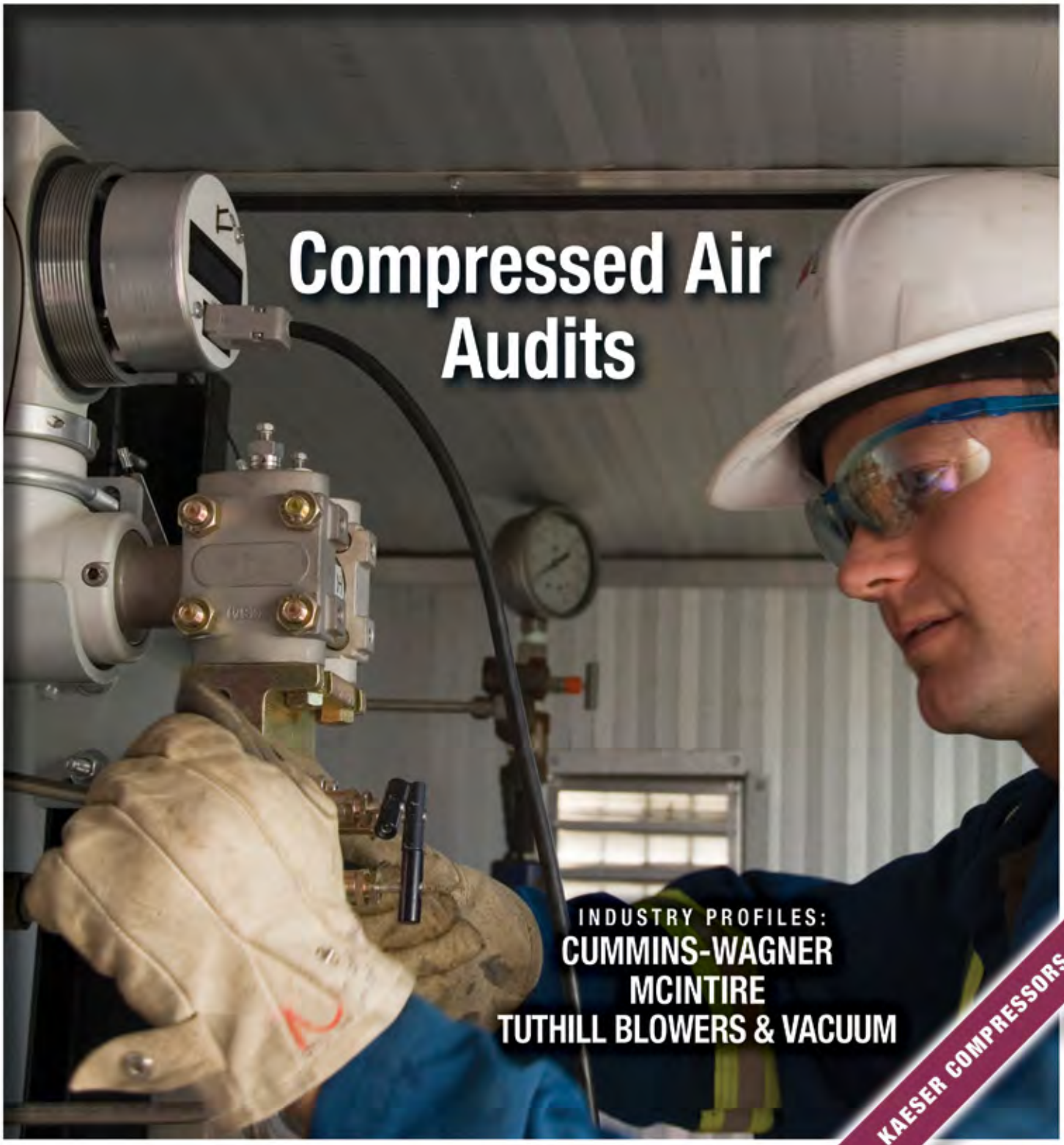
Manitoba Hydro | Puget Sound Utilities | Vacuum Audit

August 2008

COMPRESSED AIR BEST PRACTICES™



Compressed Air Audits

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FROM THE EDITOR

Compressed Air Audits

Creating this edition on "Compressed Air Audits" has been very motivating for me. I have had the opportunity to speak with many people who are very passionate about saving energy. It's contagious and great to see how many companies really "get it."

We continue to emphasize the "Win/Win" characteristics of industrial energy-saving projects. It's a win for company profits and a win for the environment. I like the environment perhaps more than the average Joe — but I can't afford to hurt my business for a second because there are mouths to feed. We always emphasize industrial energy savings opportunities, which are about the "Win/Win" scenario symbolized by our logo on this page.

Utility companies can have a profound impact on the level of industrial energy-saving projects in a region. Seattle City Light and Tacoma Power describe how they have structured their incentive programs around VERIFIED energy savings. It is my hope that a utility company without a program will read this article and be inspired to construct their own incentive program for compressed air projects.

If a utility company has a budget but no staff to manage the program, Ecos Air out of Seattle tells us how they manage a portion of Pacific Gas & Electric's budget for compressed air projects. They offer a turnkey solution for utility companies willing to finance projects but not interested in hiring a staff to implement projects well.

Two veteran and expert "implementers" provide us articles emphasizing the use of flow meters to truly understand what is happening in a compressed air system. Ron Marshall (Manitoba Hydro) and Babu Joseph (Southern California Edison) provide examples of what can happen if you don't measure flow and information on how to use flow meters accurately.

In closing, my best regards go to the President of Kaeser Compressors, Mr. Reiner Mueller, who has announced his retirement this month. The U.S. compressed air industry and countless people (myself included) are fortunate to have worked with him.

Thank you again for your support.

ROD SMITH

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UTILITY-AIR NEWS

Kaeser Compressors Announces Retirement News

Reiner G. Mueller, President of Kaeser Compressors, Inc. has announced he will retire at the end of 2008. Mr. Mueller is the most senior and longest serving president in the US compressor industry.

Mueller was hired by Carl Kaeser of Kaeser Kompressoren in Coburg, Germany to establish Kaeser's US subsidiary in 1982. He began with only a handful of employees, a modest 10,000 sq. ft facility and a small but committed network of independent industrial distributors. Today, Kaeser is represented across the country by an extensive factory-trained distribution network as well as factory stores. Customers and distribution alike are supported by Kaeser's 100,000 sq. ft. headquarters facility in Fredericksburg, Virginia, which was completed in 1995 under Mueller's personal direction.

In addition to serving as president of Kaeser's US subsidiary, Mueller also established and oversees subsidiaries in Latin America including Argentina, Brazil, Canada, Chile, Colombia, El Salvador, Guatemala, Honduras and Mexico. He also played a critical role in establishing distribution in Bolivia, Costa Rica, Ecuador, Panama and Peru.

Citing 26 years of service and a desire to spend more time with his family, Mueller indicated the decision was not made lightly and had been in process for the last two years. "Establishing Kaeser Compressors in the United States and the Western Hemisphere has been my life's work. I have worked side-by-side with many fine individuals and enjoyed every challenge along the way." Frank Mueller, current Executive Vice President and General Manager will take over US Operations in January 2009.

For more information, visit www.kaeser.com

Ultrasound World V

UE Systems has announced that Ultrasound World V will take place January 18–21, 2009 at the Hilton Clearwater Resort in Clearwater Beach, Florida.

The conference will help industry learn how to save energy, enhance production and increase profitability through ultrasound and other plant operation technologies.

For more information, visit www.uesystems.com

ITP and Utilities Partner to Improve National Industrial Energy Efficiency

Representatives from the U.S. Department of Energy's (DOE) Industrial Technologies Program (ITP) met with representatives from utilities, utility associations, state energy offices, power administrations and other utility stakeholders on February 14–15, 2008, in Laurel, Maryland, to discuss how ITP and utilities can partner to improve the energy efficiency of the utilities' industrial customers. As a result of this meeting, the Utilities Working with Industry: Action Plan was produced. The action plan outlines the highest priority activities for ITP and the utilities to complete to reach ITP's goal of driving a 25% reduction in industrial energy intensity in 10 years.

Utility account managers, energy efficiency managers and other associations can look to the action plan to find out how they can work with ITP to improve industrial energy efficiency. A coordinating committee will be created to steer the key activities outlined in the action plan. These include:

- The Save Energy Now Voluntary Agreement for Utilities, which will be geared toward manufacturers and energy service companies. By signing the agreement, participants demonstrate their commitment to help lower the energy intensity of their industrial customers.
- ITP and the utilities will form an open dialogue with regional energy and climate change associations to discuss new energy efficiency and/or climate change legislation mandated or being considered for their state.
- To help utilities improve their industrial customers' energy efficiency, ITP and the utilities will team up to create technical information, increase education and training opportunities, extend outreach to utility managers and regulators and recognize utilities/plants that have made notable progress toward improving industrial energy efficiency.

For more information, visit www1.eere.energy.gov

Compressed Air Audit of the Month

A Vacuum System Audit

By Dan Bott

August Audit of the Month

Where: United States
Industry: Furniture Manufacturing
Issues: Insufficient vacuum causing part slippage on routing tables. Creating product rejects and production downtime
Audit Type: Vacuum Supply and Demand

Financial Summary

Investment: $458,725
Energy Cost Before Investment: $338,759
Energy Cost After Investment: $199,255
Energy Savings/Year: $139,504
Incremental Energy Cost Avoidance: $98,000
Power Cost/kWh: $0.065
Operating Hours/Year: 6760
Simple Payback: 3.3 years

System Before Audit

Average Air Flow: 11,020 ACFM
System Vacuum Level: 16" HgV
Eight Rotary Screw Vacuum Pumps: 790 BHP

Proposed System After Audit

Average Air Flow: 16,000 ACFM
System Vacuum Level: 12" HgV
Three Rotary Lobe Blowers: 530 hp

A. Introduction

The audit was initiated to investigate methods for increasing vacuum delivery to production CNC cutting/routing machinery. Better vacuum delivery is needed due to an elevated level of part slippage on the routing tables. This situation is hurting productivity and increasing waste costs.

The solution to part slippage on routing tables is to eliminate or reduce the vacuum differential in the distribution system and within point-of-use routing equipment. Elimination of differential pressures will result in more holding force available for parts. However, reducing pressure differential will also allow for more air to enter the vacuum system resulting in the need for additional supply capacity.

There are two alternatives to solve this issue. First, the site can elect to purchase additional rotary screw vacuum pumps. This will provide enough capacity to keep site vacuum above 15" HgV. This action will require capital funding and additional operating expenditures for energy. The second alternative is to replace the existing rotary screw vacuum pumps with rotary lobe blowers. This alternative will reduce energy expenditures, provide for higher capacity at lower vacuum levels and generate a payback on production machinery modifications and capital investments.

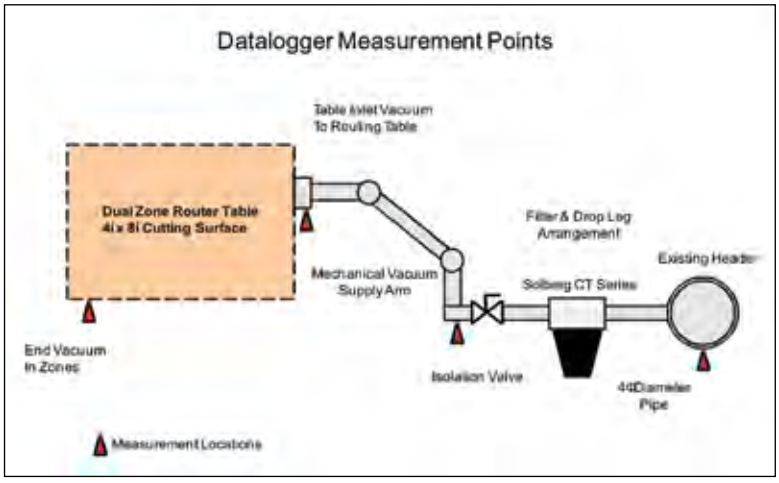
B. Vacuum Distribution Issues

The vacuum distribution system was analyzed from the supply source (the rotary screw vacuum pump outlet) to the point-of-use (the routing tables).

Measurement

There are six primary locations where vacuum measurements were taken:

1. The 12" diameter supply header loop
2. Inlet filters located in each drop leg
3. The vacuum feed to the table where the table isolation valves are located
4. The mechanical arm to each table
5. The vacuum inlet to each table located at the end of the mechanical arm
6. The far side of each table opposite from the vacuum inlet



Drop Legs

Drop legs in the distribution system are one of the causes of poor vacuum performance to production machinery. Drop legs at the old-style routers are 4" diameter PVC that split in two branches to supply two tables at each router. In line in each branch is a Solberg Model CT vacuum filter. A 4" diameter PVC pipe connects these vacuum filters to each routing table at the primary isolation feed valve located near the floor.

Pressure differential was measured from the 12" diameter primary supply loop to the vacuum feed valve and was found to be 3" HgV total which includes the canister style inlet filter. The existing canister style vacuum filters were tested and were found to have a pressure differential of 1.5" HgV during normal operation and moderate loading. Pressure drop of this magnitude is significant in that reducing pressure drop in supply piping will directly increase vacuum holding force at use points. Increased holding force results in fewer waste problems related to vacuum and a possible increase in machine production throughput.

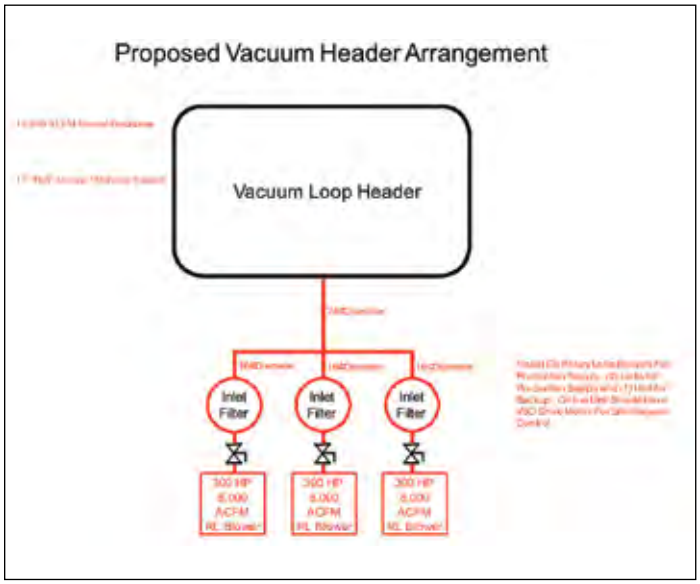
We are recommending that the 4" diameter PVC drop legs be replaced with 8" diameter drop legs to reduce the pressure differential. *Note that 90° elbows and changes in direction should be kept to the absolute minimum. All necessary elbows should have large radius turns, and "T" connections should be "Y" connections if possible. This is true of all piping modifications for vacuum service. Vacuum piping should be as straight as possible, as short as possible and have large diameters.*

Vacuum Filters

The canister style vacuum filters on the old style router drop legs are adding 1.5" HgV pressure differential. These filters are cleaned several times each day and serve as the first and primary protection for the vacuum supply pumps. To eliminate the existing pressure differential, we are recommending that the canister style vacuum filters are replaced with Solberg "L"-style CSL filters. These filters have a paper filter element with a pressure drop of 2.05" H2O (0.15" Hg) at a flow rate of 1,000 scfm. Connection size for this filter is an 8" flange. The addition of an 8" diameter drop leg to each machine and installation of one of these filters per old style table (20 total) will reduce pressure differential to less than 0.3" HgV per table.

COMPRESSED AIR AUDIT OF THE MONTH

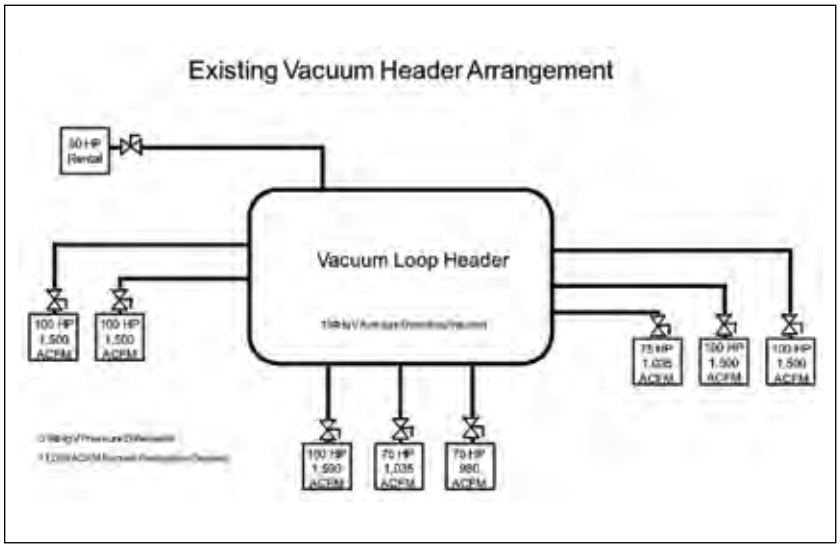
A Vacuum System Audit



Vacuum Header and Connectors

The new style routers will require a 10" diameter connector to the primary header and 10" diameter drop legs to each table. When the drop leg splits into two feed lines to each table, pipe diameter can be reduced to 8". Pressure differential was measured from the primary header to the point-of-use filter in the new router area. Pressure differential was 2" HgV. The inlet filter was measured with a handheld meter and was found to add another 1.5" HgV pressure differential. We are recommending the installation of Solberg CSL inlet filters to each of the four new router tables where the 10" diameter drop leg is reduced to 8" diameter.

The central distribution header consists of 6" diameter and 4" diameter connectors from each vacuum pump to a primary 12" diameter vacuum header loop that extends over production machinery. There is approximately 1" HgV pressure differential in this header during normal production demand loading.



In the projected scenario, there will be three 300 hp rotary lobe blowers where two will handle the entire production load and the third will be used for alternation and back up. A 24" diameter trunk header will be necessary to provide for low pressure-drop and adequate flow characteristics. The trunk header should extend from the three vacuum pumps to the far end of the 12" diameter loop and connect at each cross bar. Making these changes in the distribution system will allow for maximum vacuum delivery to use points. Note that any connection to the primary header, drop legs or splits to production machines should be made with full ports i.e. 6" diameter pipes connected to 6" diameter primary header connections. Do not use (for example) a 4" diameter existing connection in the header for 6" diameter pipe.

C. Vacuum Demand Issues

Testing was completed on two types of production machines, a modified table and a standard table, to determine the shape of the vacuum supply profile inside production machinery during normal operation. Testing was completed with high-speed data loggers that read vacuum levels 10 times per second.

The Modified Router Table

The modified router table was tested simultaneously at each of the two vacuum ports on the table (table inlet and table end). When cutting started, supply pressure at the table inlet was 8.5" HgV and as cutting progressed, vacuum level dropped to 4.4" HgV. The critical point to note here is that the vacuum level at the end of the table was only 3.1" HgV and production was operating normally.

Between several tests, there was approximately 1.3" Hg pressure differential between one end of the table and the other. This level of measured pressure differential is very low in comparison to similar equipment in other applications. This indicates excellent design work in modifying the table. The low vacuum supply level indicates that if pressure differential can be lowered in other areas, production machinery will experience an increase in vacuum holding force. This increase will be enough to eliminate part movement and lower the existing scrap rate.

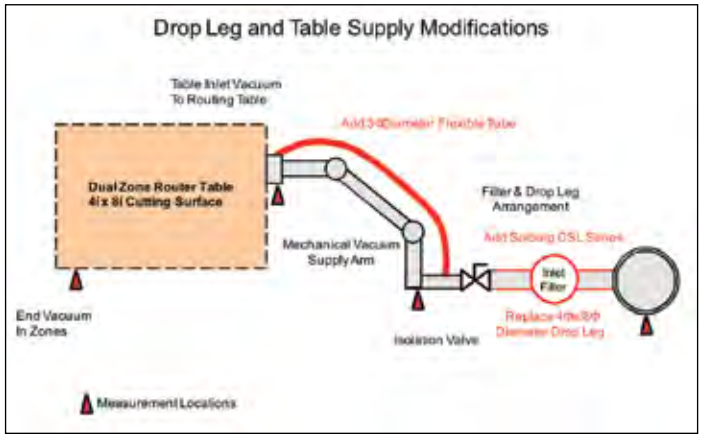
Currently, when central header vacuum level fluctuates, there is a point where there is not enough holding force to prevent part movement. This point was not established during the audit due to lack of time for testing. It is estimated that the existing 3" HgV (approx.) is very close to the critical vacuum level and that even changes in barometric pressure can affect holding force significantly.

The Old-Style Routing Table

Testing was also completed on a standard, old-style routing table to determine if the same pressure profile exists on the unmodified tables. A much more alarming situation exists in the standard tables due to the fact that the vacuum at the farthest end of the production table was 6" HgV less than the vacuum inlet. This is 4.5" HgV more than the vacuum differential measured on the modified table. We are recommending that the remaining old-style production machine tables be modified over time with the changes already incorporated in the "newer modified" tables. All internal restrictions to vacuum flow within each table should be removed or alleviated. These changes can be made during normal maintenance intervals so that over time all production machines will be modified.

COMPRESSED AIR AUDIT OF THE MONTH

A Vacuum System Audit



Mechanical Vacuum Supply Arm

The mechanical vacuum supply arm was tested on both the modified table and on the standard table and was found to be a significant source of pressure differential. Pressure differential was found to be any where from 3" HgV to 5" HgV for the mechanical arm. When cutting starts, there is not the maximum amount of air flow through the arm and therefore low pressure differential. As cutting progresses, air flow and pressure differential increase. These types of mechanical vacuum supply arms are historically significant sources of pressure differential, but they are needed due to the motion of the table on two axis. One potential solution is to attach a flexible hose to the mechanical arm and supply vacuum in parallel to the arm itself. To do this effectively, a new table inlet fixture must be installed. The table inlet must have an extra port to connect the vacuum supply tube with the existing inlet/mechanical arm arrangement.

Flow Rate from a Table

A flow test was conducted to determine the flow rate from a standard routing table and a modified routing table. The test was set up so that only one 100 hp vacuum pump was operating during a lunch break. All other vacuum pumps were shut down and all production machines were closed off from the vacuum system with the exception of the machine being tested. Modified table #ZTR-2 was tested first and was found to flow 451 scfm initially and as cutting continued reached a maximum of 558 scfm. Standard (unmodified) table #ZTR-4 was tested using the same cutting program and was found to flow 344 scfm when cutting started and 439 scfm at peak flow conditions.

The differences in flow rate can be attributed to the lower differential pressure on the modified table. This indicates that when changes are made to system components that exhibit high differential pressure, airflow will increase into the vacuum system. This will lower the vacuum level further if capacity is not available to remove the additional air.

It is important that testing be completed on a completely modified table (table, mechanical arm and drop leg) to determine the maximum flow rate, the allowable pressure differential and threshold vacuum level for the smallest part manufactured.

Automatic Shut-Off Valves

Automatic shut-off valves to the central vacuum system are installed on most of the production machines and should be installed on all remaining units so that when production machinery is off or in standby mode, the vacuum supply is also off. The addition of positive closure valves will keep non-productive vacuum use to a minimum by ensuring supply closure during machine downtime. The shut-off valves in place should be checked for proper functioning.

Specify 12" HgV

All new production equipment scheduled for this facility should have specifications for normal operation with supply vacuum at 12" HgV or below. This will ensure that all new production equipment will be able to work within the new system parameters.

Constituents of Demand in ACFM

	Normal Production		Low Production	
Low Pressure	existing	proposed	existing	proposed
Existing CNC Routers	8,400	12,000	8,400	12,000
Additional CNC Routers	2,400	4,000	2,400	4,000
Leaks	220	0	220	0
Totals:	11,020	16,000	11,020	16,000
	11,020		11,020	

Notes:	
Existing CNC Routers	740 ACFM each
Additional CNC Routers	1,500 ACFM each
Leaks	Leaks from existing filters
Proposed	Operation at 12" HgV w/blowers

D. Vacuum Supply Issues

The central vacuum system of eight existing rotary screw vacuum pumps supply site requirements for vacuum. There is 675 nameplate horsepower in vacuum pumps of which 790 actual brake horsepower is being used during normal production. These pumps deliver a total of 11,020 acfm at an average header vacuum level of 16" HgV.

Vacuum pump amp draw and vacuum level at the vacuum pumps varied significantly during the audit indicating a fluctuating demand load from production equipment. The only significant change in vacuum level occurs during shift change and breaks when vacuum levels increase to approximately 28.6" HgV. Note that data-logger graphs read vacuum in PSIA. Readings are converted on each graph to "HgV to illustrate significant points. If further conversions are necessary, the formula to convert PSIA to HgV is: **HgV = 29.92 - (PSIA x 2.04).**

Rotary Screws Designed for 15" HgV to 29.5" HgV

The rotary screw vacuum pumps are designed for service in the vacuum range of 15" HgV to 29.5" HgV. When system vacuum level drops below 15" HgV, a modulating inlet valve built into the inlet of the vacuum pump begins to close. This valve is in place so that the pump side vacuum level does not drop below 15" HgV. If the vacuum level at the inlet to the rotary screw vacuum pump did drop below 15" HgV, high amp draw and motor overload would result. The 15" control valve keeps the mass flow low enough for reasonable motor performance.

The 15" control valve is important in this system because as pressure differential modifications are made to the distribution system and production demand equipment, more air will be flowing into the system and system vacuum level will drop from the existing 16" HgV to some lower value, possibly as low as 12" HgV. When the system vacuum level drops to 15" HgV, inlet control valves on site vacuum pumps will begin to close and capacity delivered to the system will decrease. In this scenario, the 15" control valves will be counteracting the effects of decreasing the pressure differential by not allowing full delivered capacity. The result will be a cascading loss of vacuum. In other words, the existing vacuum pumps, by having built-in protection devices, will diminish system supply capacity when vacuum levels drop.

Rotary Lobe Blowers

There are two alternatives to the 15" control valve restriction. The first is to install more rotary screw vacuum pumps so that the additional air entering the system can be evacuated and system vacuum level will remain at 15" HgV or greater. It is estimated that this will require an additional 300 hp in rotary screw vacuum pump capacity to reach the new 16,000 acfm level required to keep the system vacuum level at 15" HgV. 300 hp will cost $98,000 per year for energy at $0.065 kW/h. Note that the primary goal is to increase vacuum holding force to use points in production machinery.

The second and recommended alternative is to target 12" HgV vacuum levels. We will make modifications to production machinery and to distribution piping and then change vacuum supply technology from rotary screw to rotary lobe blower. Rotary lobe blowers typically operate in the 0–15" HgV vacuum range and are a more efficient technology than rotary screw in applications below 15" HgV.

Given that table end vacuum levels are only 3" HgV and table inlet vacuums range from 5" HgV to 9" HgV, it would be much more efficient to supply high volume vacuum capacity at 12" HgV and have only 3" HgV to 4" HgV of total pressure differential and still supply vacuum to parts at 7" HgV to 8" HgV. This is 4" HgV to 5" HgV higher vacuum than what is currently available in production machinery and would eliminate part slippage and waste.

E. Summary

A furniture manufacturer was experiencing insufficient vacuum causing part slippage at the routing tables. This caused product rejects and production downtime. The proposed solution is to go from 15" HgV to 12" HgV vacuum and to increase flow from 11,000 to 16,000 acfm.

Eliminating pressure losses in distribution systems and at the routing tables is a key concern. It is recommended to replace the rotary screw vacuum pumps with rotary lobe blowers, which operate more efficiently at 12" HgV. The resulting energy savings of the project are predicted to be $139,504 with a payback period of 3.3 years. BP

For more information please contact Dan Bott, Dan Bott Consulting, tel: 251-609-1429, email: dan@dbott.com, www.danbottconsulting.com

ENERGIZED

for Savings at Seattle City Light and Tacoma Power

BY ROD SMITH

After spending three days in Seattle in May, I realized I hadn't had this feeling since my trip to the 2007 Hanover Trade Fair in Germany. It's arriving to a place where tons of people think like you do. You may be completely different, but you have the same passion and opinion on an important topic. In this case, the topic is the business of saving energy. I was able to meet with two major catalysts for industrial energy-savings in the Puget Sound area; Seattle City Light and Tacoma Power.

The Business of Saving Energy in Compressed Air

Seattle City Light has completed, over the past years, 89 compressed air projects with first-year savings of 11.2 million kWh off of the bills of their customers. That's worth approximately $565,161 in first-year savings. Tacoma Power has saved their customers over 4.2 million kWh (first-year savings) over the past three and a half years alone.

Variable Speed Drive Compressors and Multiplex Cycling Dryers Capture Rebate Funding When Properly Applied

Saving energy tends to be viewed in one of two ways by industry. When mentioned, some business people immediately become suspicious, hide their wallets and begin to look for signs that you might wear Birkenstocks. Others intuitively lean forward and begin listening for a sound investment opportunity in one of the fastest growing industries in the world. The "business of saving energy" for this writer represents the situation when "saving energy" provides a compelling financial business case for the investor.

The Puget Sound utility companies are doing an outstanding job of acting as a catalyst for industrial energy-saving projects. We had the opportunity to speak with managers at both Seattle City Light and Tacoma Power about their programs. **Greg Whiting,** Manager of Energy Conservation at Seattle City Light said, "We are a zero-carbon footprint utility. Industrial energy-saving projects are a critical component of our strategy." Both utilities understand that their customers have businesses to run and that when business interests are met, significant projects can be done to reduce kW consumption.

Invest in Staff to Verify ROI on Compressed Air Projects

Compressed air systems typically provide excellent opportunities for energy-saving projects with attractive ROI's. Both Tacoma Power and Seattle City Light focus on ROI verification. Strong verification processes provide both the utility company and the industrial business that their capital has been deployed wisely.

Verification begins with the utility company investing in having a staff trained to understand compressed air systems. Some utility companies have simply created an incentive budget and an application form. Without a qualified staff, they never found out if their capital had been well spent and worse — neither did their industrial customers.

Gary Johnson is a Senior Engineer at the Energy Services team at Tacoma Power, "When our Account Executives identify an opportunity, I will visit the factory, explain our program and do a personal assessment of the opportunity." Having a staff member who can speak directly to the customer about available funding and the potential opportunity is invaluable as it eliminates financing misperceptions and unrealistic projects.

At Seattle City Light, the industrial team is typically made up of four people. Account Executives feed potential projects into the team. The industrial team consists of a lead engineer who does field audit and verification work with the customers and also reviews the on-going projects with the team. The other three people are energy management analysts with technical backgrounds, who can act as project managers.

ENERGIZED FOR SAVINGS AT SEATTLE CITY LIGHT AND TACOMA POWER

Company: Manke Lumber Company

Industry: Integrated Lumber Processor

Location: Tacoma Tideflats

Utility: Tacoma Power

Original Installation: Expansion of operations over thirty years and adding air compressors to keep up. Deficiencies included inefficient compressor controls, excessive piping distribution losses, inadequate air storage to meet peak demands and the inability to turn off compressors during non-peak times. The system ran continuously but had frequent downtime periods causing lost production.

New Installation: New variable speed drive 350 hp air compressor and 300 hp fixed-speed air compressor were installed along with a new speed-control package on the existing 300 hp air compressor. A multiplex cycling dryer along with two 2,560-gallon air storage tanks was installed. Distribution piping was modified to prevent pressure drops.

Energy Cost Savings After Project-Verified: 923,536 kWh ($38,244)

Project Costs: $313,348

Incentive: $110,824

Simple Payback: 5.3 years

Company: Puget Sound Coatings

Industry: Surface Preparation and Coating

Location: South Seattle

Utility: Seattle City Light

Original Installation: Originally had a 400 hp and a 250 hp air compressor working in modulation. They would fight each other — one would ramp up and the other would ramp down. Facility has large demand events from sand blasting and painting.

New Installation: A 215 hp variable speed drive air compressor and two 125 hp fixed-speed air compressors. A fixed speed is more efficient at 100% loaded than VSD. The fixed speeds were used as base-load air compressors.

Energy Usage Before Project: 1 million kWh

Energy Usage Projected by Project: 425,000 kWh

Energy Usage After Project-Verified: 350,000 kWh

Incentive: $90,000

Simple Payback: 2 years

"Pay for Performance" Incentives

In keeping with the focus on ROI, the incentive programs offered by both utilities focus on "Pay for Performance" models. This begins with the Demand-Side Assessments (DSA's), which can include compressed air leak audits. A DSA at Tacoma Power will be financed to 50% of the cost. "Paying 50% keeps the customer committed to implementing the project," says **Peter Meyer** (Assistant Energy Services Manager, Tacoma Power). Average total cost for a DSA is $3,000. The DSA will identify and tag all the compressed air leaks. The facility must ensure that they are all fixed. Tacoma Power will loan the customer ultrasonic leak detection equipment (if necessary) to check the status of the leaks. Tacoma Power pays for 100% of their 50% share of the DSA cost — only if 100% of the major leaks are fixed.

The "Pay for Performance" model is also applied to Energy Conservation Measures (ECM's), which involve the replacement of equipment and systems. Both utilities will use an outside vendor to conduct a full audit. "The project must be delivering at least 85% of the projected savings after verification, or the customer is on the hook for 100% of the incentive funds promised the customer," said Gary Johnson. This forces the vendor doing the auditing to be very accurate in forecasting energy savings.

A Bright Future for Projects

When asked, "why do you pay customers to buy less from you?" both utilities quickly respond it is a better investment to pay for reduced consumption rather than to build new power plants. Tacoma Power is 90% hydro. They generate some of their own power and also buy some from the Bonneville Power Administration (BPA). The average cost of power from Tacoma is around 4½ cents per kW (including peak demand charges). The incentives provided by Tacoma Power are normally 12 cents per kWh. Tacoma Power's current two-year budget for projects is $372,000. The utility already has plans for a major project in 2009. If things work out as projected, the project will receive $150,000 in incentives while delivering 2 million kWh in savings.

Seattle City Light has a mature Conservation Program. Started in 1982, they "did a lot of controls projects in the 90s and we now focus on variable speed drive (VSD), cycling dryers, no air-loss drains and storage projects," said **Aaron Houseknecht,** an

Account Executive at Seattle City Light. The budget is integrated into the $7–9 million annual Commercial Incentive Program, which includes many industrial processes. "We have three different incentive levels depending upon the size of the project," said Jim Evans, a Energy Management Analyst at Seattle City Light. The three levels are:

1. **Level 1:** Very large installations (>250 hp installed). Work with outside consulting firms. Offer up to 100% financing of the audit. Offer up to 23 cents per kWh on projects up to 70% of the total installed cost (40–50% is average).
2. **Level 2:** Average installations (<250 hp installed). Work with local vendors or do the audit ourselves. Offer up to 23 cents per kWh on projects up to 70% of the total installed cost (40–50% is average).
3. **Level 3:** Smaller installations (<50 hp installed). We are increasingly finding smaller projects but can't justify the costs of metering smaller installations. We did a study of 20 installations and found that most run at partial loads ideal for variable speed drive (VSD) air compressors. We now offer a blanket rebate of 9 cents per horsepower per operating hour on VSD's under 34 hp.

An Example for Other Utilities

In the Northwest, it seems as though everyone is excited about the "Business of Saving Energy." These utility companies play such an important role as a catalyst. They not only provide some financing but more importantly, they give proposed projects the credibility they need. Business owners must choose wisely on how to allocate their capital — the fate of their companies rest with these decisions.

Utility companies like Tacoma Power and Seattle City Light have structured their programs so that ROI's are guaranteed. We hope that other utility companies will take note of how they have structured their compressed air incentive programs. We have huge areas in the U.S., which are very industrial, where there is a huge opportunity for the utility companies to get involved with "the Business of Saving Energy." BP

For more information, contact Rod Smith, Editor, Compressed Air Best Practices™ magazine, tel: 251-680-9154, email: rod@airbestpractices.com, www.airbestpractices.com

"We are a zero-carbon footprint utility. Industrial energy-saving projects are a critical component of our strategy."

— GREG WHITING, MANAGER, ENERGY CONSERVATION, SEATTLE CITY LIGHT

Know Your SYSTEM

BY RON MARSHALL, CET, CIM, MANITOBA HYDRO

Introduction

As the editor of the Compressed Air Best Practices™ magazine rightfully observed in his May 2008 editorial feature, there is a fundamental and problematic issue common to the compressed air industry. It is the simple need to better measure what is going on in industrial compressed air systems. As Manitoba Hydro's "Industrial Compressed Air Guy" I have reviewed and analyzed data from hundreds of air systems, from the very smallest systems in "Joe's Body Shop" to the very largest sites using multiple huge centrifugal compressors capable of producing 30,000 cfm each. I can tell you that most compressed air system users have no idea how much air their system is producing, what the energy intensity of their system is or how much it costs to produce the air. These users are almost always surprised when we show them the real picture.

There is a real need for better measurement strategies for air systems. It is mind boggling to think of how much money is wasted to keep inefficient air systems running, all because the users can't see the real picture for themselves. If they did, many would quickly implement correction strategies before their bosses found out. This article tells of some of our experiences with compressed air system monitoring.

Background

Manitoba Hydro, a power utility located in the Province of Manitoba, Canada, first started exploring the issue of compressed air efficiency in the early 90's when key personnel attended a seminar given by Scot Foss, one of the top compressed air professionals in the world, and one of the catalysts in the emerging compressed air efficiency efforts at the time. Manitoba Hydro's efforts in this area, under the leadership of Rob Armstrong, embraced the "system approach" and recognized that awareness of the costs of compressed air is one of the keys to influencing system improvements. One of the main benefits of this improvement, and the one that most interested Manitoba Hydro as a power utility, was increased energy efficiency.

About the same time, Manitoba Hydro launched a number of industrial energy efficiency incentive programs, one of which is called Performance Optimization. This program, which focuses on stimulating improvements to electrically powered processes and motor driven equipment, fit perfectly with the idea of compressed air efficiency. This program makes both system experts and financial resources available to interested customers to help study their systems and, if appropriate, help pay some of the capital costs required for system improvements. Since the start of the program, there have been compressed air scoping studies and/or full plant air audits performed at over 570 facilities, many resulting in successful compressed air efficiency projects.

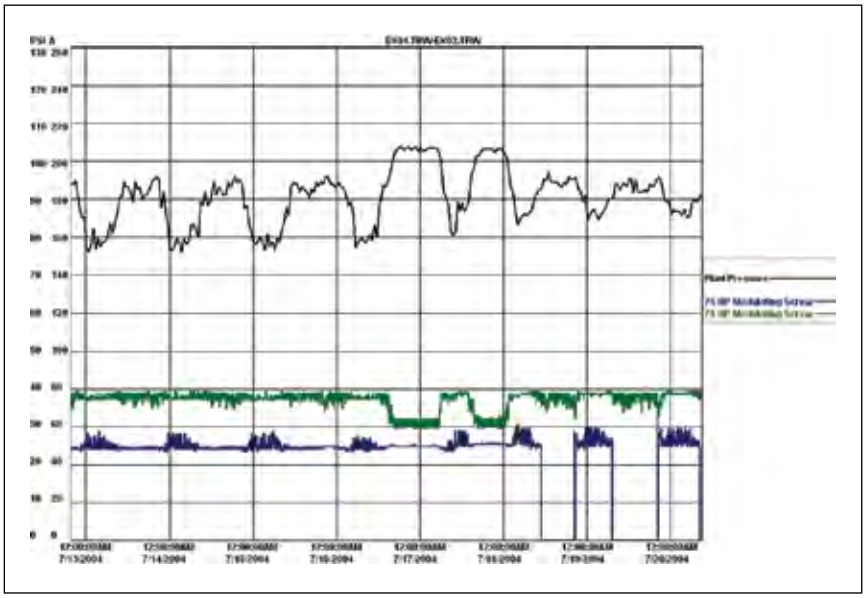


Figure 1 — Shows the amp response to pressure fluctuations in a typical two compressor modulating screw compressor installation. This system has very poor pressure regulation and low efficiency.

Data Logging

Key to our efficiency efforts are site scoping studies, which are basically enhanced plant walk through audits, where brief site observations are done and nameplate data collected. During these studies data loggers are placed on the compressed air system to determine the air system profile. The duration of this data logging is normally 7 days, where the concept is to catch a full plant production cycle and get a general idea of how the system is operating. These scoping studies are not intended to be as accurate as full system audits and therefore only consist of basic pressure logging at a few strategic points to determine system stability and pressure differentials; and amp logging to determine the response of compressor amp input to changes in pressure. If the data is plotted on a graph using a time scale, a system profile will be created that will reveal key system characteristics. An experienced eye can use these graphs like a doctor uses an EKG and diagnose a number of system issues very quickly. An example of such a chart appears in Figure 1.

After calibrating the amp data to measured power at various compressor loading levels, a power consumption estimate can be calculated. If the load profile captured during the data logging represents the average loading throughout the year, a projected annual system energy consumption total can be fairly accurately estimated.

Further to this, the approximate flows produced by each compressor can be estimated by observing the average amp characteristics at various times. The average amp loading versus percent loading, for reciprocating and screw compressors, follows certain characteristic curves, with each curve depending on the applicable compressor control mode. Example curves for various control modes are shown in Figure 2. A commonly used method of determining the flow output of screw

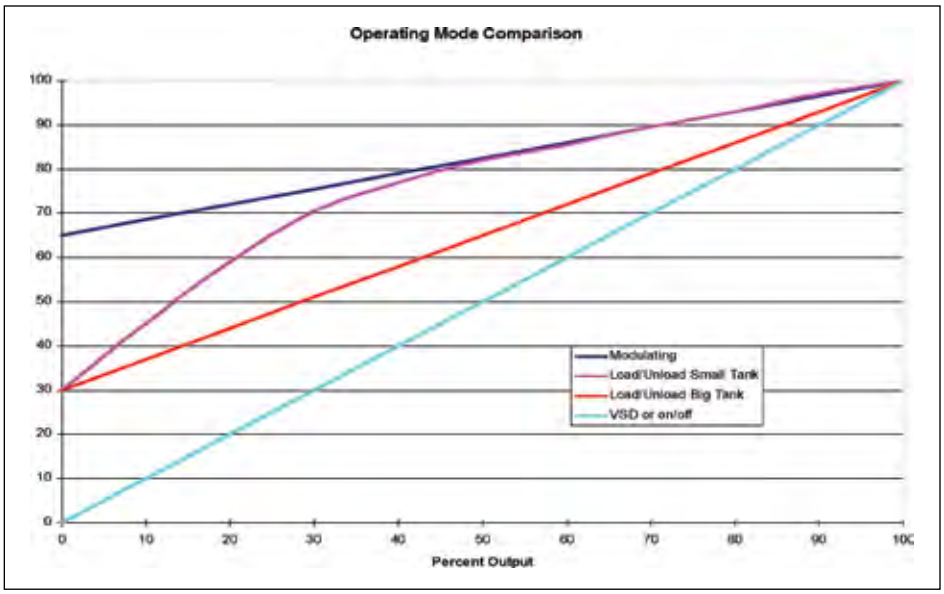


Figure 2 — Comparison of typical compressor operating modes. Note these curves have been simplified for illustration purposes and may differ from actual curves depending on individual compressor characteristics.

KNOW YOUR SYSTEM

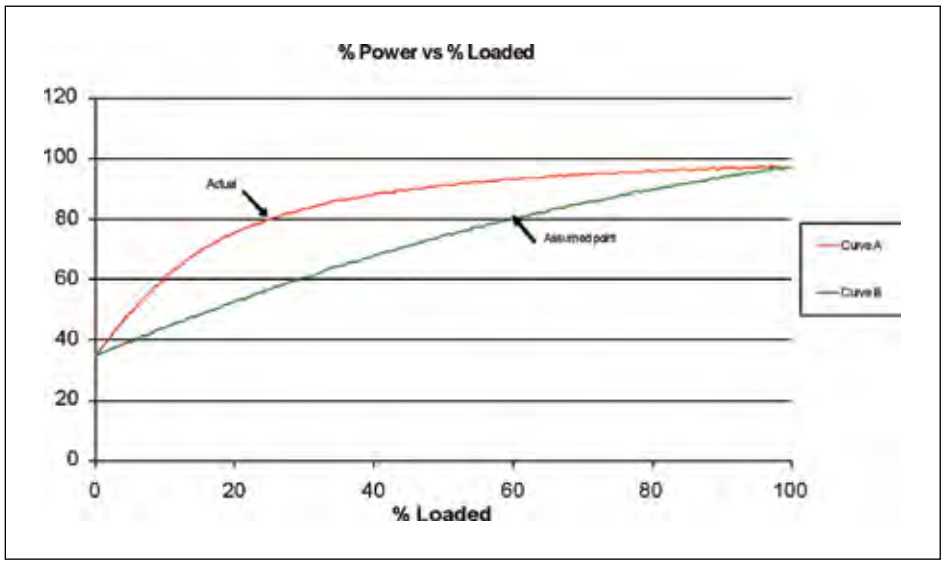


Figure 3 — A compressor with slow blow down characteristics due to a malfunction might follow Curve A rather than its rated Curve B. At 80% power the compressor would be assumed to be 60% loaded when it is actually only running at 25% output.

compressors is to construct a theoretical curve from the measured maximum and minimum amp readings, at zero and 100% flow, and then pick the flow at various actual operating points off the curve. This is one of the methods used to calculate flows using the US DOE's AirMaster+ software, (http://www1.eere.energy.gov/industry/bestpractices/software.html#air) a tool that can be used by compressed air users to optimize their air systems.

Once system flows are known, flow profiles can be constructed. These flow profiles are then used to calculate "what if" scenarios of different control strategies, alternate compressor types and/or lower flows due to leak reduction, or other efficiency efforts are implemented. Using the theoretical curves for these new scenarios and reversing the previous calculations, resulting projected new system power consumption can be estimated. The comparison of the existing energy consumption to the new consumption can be used to calculate potential savings if efficiency measures are implemented and to help justify project expenditures.

Results Can be Off

Unfortunately real-world conditions can sometimes throw a wrench into theoretical calculations. Numerous conditions can affect the actual amp and power input to a compressor and/or the air output. The amp readings, for example, can be affected by changes in voltage. Many industrial sites have fluctuating voltage at the compressors depending on the capacity of the plant power distribution system.

Part way into our study experience, Manitoba Hydro started seeing significant issues with estimates done for certain types of compressors, such as ones that have inlet valves with no visual indication of their position. If the customer is fortunate enough to have a compressor with an inlet valve with an external linkage, or a compressor with a capacity gauge, it is a relatively easy task to calibrate the amp or power readings to the theoretical curves. But some compressors have valves that are fully internal and the exact position cannot be determined during the calibration phase. This can lead to large errors in flow estimates.

Load/Unload with Blow Down Issues or Short Cycling

Similar issues are experienced with load/unload style compressors where varying cycle frequency and issues with blow down times can throw the real-world energy consumption off the theoretical curves. A screw compressor operating in load/unload mode is controlled by a pressure switch and operates within a set pressure band. The unit will alternately load and unload within this pressure band at a duty cycle that is determined by the percent compressor capacity. When the compressor unloads, it blows down its sump, and as it does so the compressor input power drops in relation to the sump pressure. The slower this blow down occurs the more power the compressor consumes during the transition from loaded to unloaded. Short cycling compressors or units with slow blow down will have a characteristic curve that has a more pronounced hump shape rather than the theoretical straight line between zero flow and full load. See Figure 3 for an example of this comparison.

Referring to Figure 3, a given compressor might be assumed to be operating on curve 1, but issues with the blow down time might make it actually operate on curve 2. The resulting assumed flow, at 80% input power for this unit, would be 60% of full load, when in actual fact the flow might be 25%.

Centrifugals

Major problems are also encountered when trying to estimate the output flows of centrifugal compressors using amp or power readings. Most centrifugals we have encountered in our area operate in inlet modulation mode with blow-off or bypass control to prevent the units from entering a damaging surge condition when compressor loading falls below stable flow. Centrifugals

are dynamic compressors that have limited turndown capability and will blow off the produced air to self load and prevent the compressors from surging. Due to this mode of control, where a centrifugal is being used as a trim machine, the amp readings remain near constant, while the flow can vary widely. In these cases, amp and power readings are useless for estimating flows. See Figure 4 for an example of the operation of a typical centrifugal system.

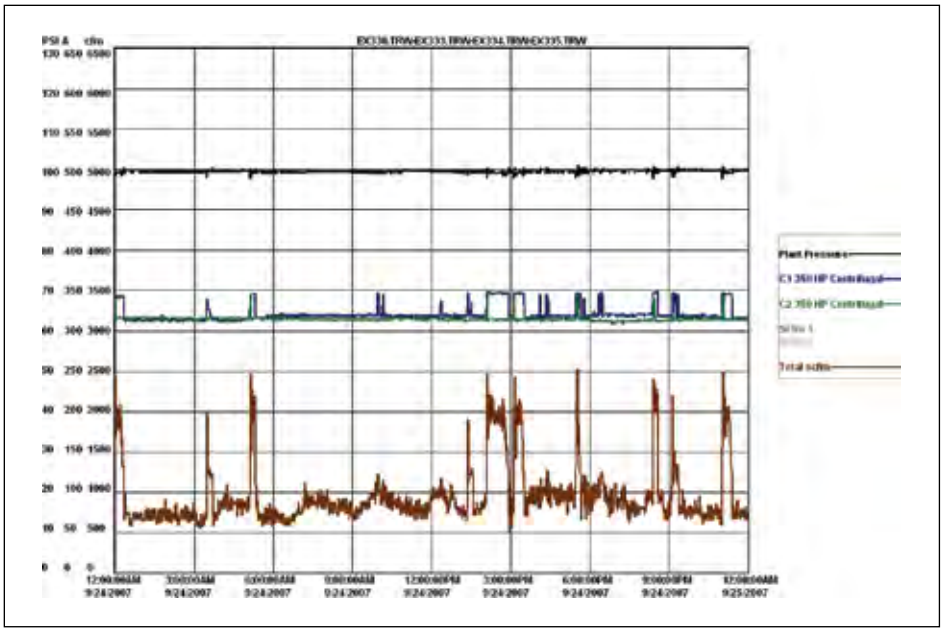


Figure 4 — Trying to determine flow from amp readings is almost impossible for this two centrifugal compressor system. Compressor blow off controls keep the compressor loading flat at low load. Adding flow readings shows the true loading and system inefficiencies.

KNOW YOUR SYSTEM

Use of Flow Meters to Determine Loading

Many different types of flow measuring devices existed when Manitoba Hydro first started performing scoping studies and audits. We found, however, many of these devices were very expensive and difficult to install, which put them way beyond the reach of all but the largest scoping projects. Many of our customers are small and were typically not interested in paying $4,000 to $5,000 for the purchase and installation of a flow meter. Fortunately, new low cost flow metering devices are now readily available that are easier to install and priced at an affordable level for initial scoping.

The device we have currently chosen for most of our installations is a thermal mass flow meter (An example of which can be seen at CDI Meters www.cdimeters.com). This type of thermal mass flow meter is extremely useful for our flow data logging using the 4 to 20 ma output, and is something our customers can use for ongoing monitoring and troubleshooting of their systems using the readable LED display. For larger jobs with pipes over 6" size, standard insertion flow meters can be used, or if applicable, the customer may have onsite flow metering with an output compatible with data loggers.

Our experience with adding thermal mass metering to our instrumentation toolbox has been positive. We are finding the extra information is very useful in analyzing the data for compressed air systems, especially on troublesome modulation and centrifugal systems. This new data also helps us better communicate the scoping test results to our customers in a simpler fashion; rather than trying to make them understand the complex method of data analysis involved in synthesizing flow data from compressor power or amps.

A Thermal Mass Flow Meter

Thermal Mass with Wet Air

Users of flow meters should be cautious, however, as certain conditions can make the data difficult to read or even completely wrong. This is particularly the case when trying to measure flow in an un-dried air stream with a thermal mass style meter. These meters must not be used with air that contains entrained moisture as under these conditions they will read incorrectly. In a compressed air system there are often times where an air stream, thought to be dry, is in fact wet due to dryer or drain failures and/or cooling/air temperature issues with the air compressors and dryer combination.

Storage Tank Location

The storage receiver location can also have a big effect on the usability of the flow meter output. For systems with large storage receivers, if the flow meter is placed between the air compressors and the receiver, the meter may not capture peak system flows where the peak is supplied by the air stored in the receiver. If the compressors in the system are load/unload style, or if system characteristics are normally highly variable, the flow meter will quickly jump from one flow level to another as conditions change, often making the meter display unreadable.

The issue of constantly changing flows can be solved by averaging the readings over a longer time period. The accompanying Figure 5 shows the thick fuzzy line that was produced in a system with highly variable flow. Overlaid on this chart is a 15 minute average. This average brings the plant flows into better focus and aids in analysis of the data.

Gas Mileage Gauge for Your Air System

Part of the way through our experience with flow meter logging, we took note of a paper by Babu Joseph, Ph.D., P.E. of Southern California Edison titled "Compressed Air Supply Efficiency." In the paper, Mr. Joseph coins the measurement unit he calls a "CASE Index" (Standard Cubic Feet per kWh) and proposes ways to monitor in real time the supply efficiency of a compressed air system.

At the same time, Manitoba Hydro was developing the use of special energy sub-meters to assist our customers in energy and demand reduction projects. An example of one such project can be seen at Manitoba Hydro's website at www.hydro.mb.ca/pop/pop_profile_inco.pdf. Armed with the CASE report and our experience with power metering, we arranged to place a number of test installations on various compressed air systems.

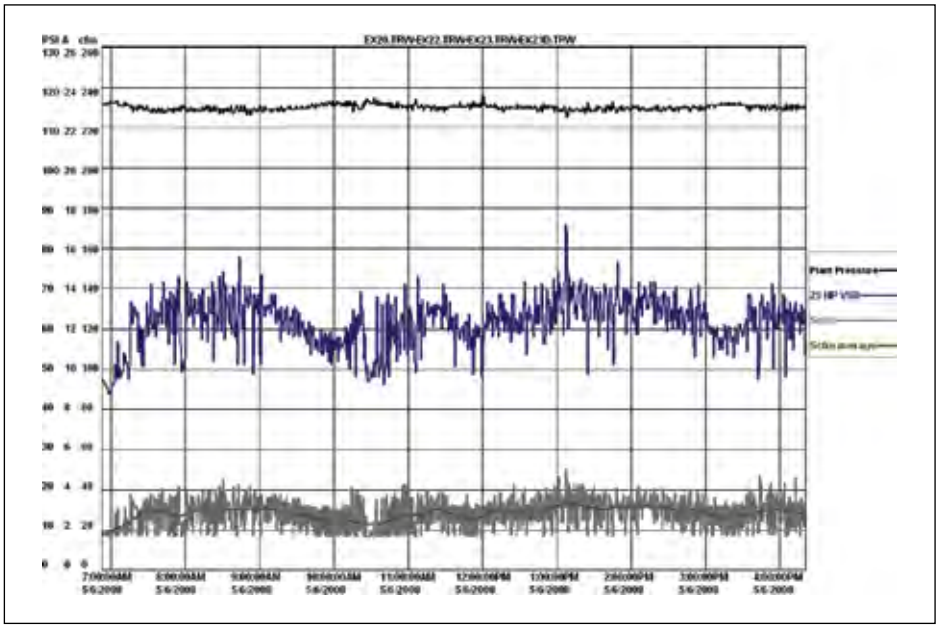


Figure 5 — The logged flow from this small VSD compressor looks like a fuzzy line and is difficult to use to track the flow characteristics. Averaging the reading simplifies the analysis.

These new systems use Power Measurement ION® type meters that are capable of reading inputs from external devices such as flow meters and pressure transducers. Using the flexibility of these meters and the accompanying ION® Enterprise software, these metering systems work like a "gas mileage gauge" and "odometer" for compressed air and tracks compressed air system input power, energy, demand, air flow, accumulated cubic feet and a number of other useful parameters.

KNOW YOUR SYSTEM

Results from the Field

Some interesting examples of the results of our using flow and power to assess systems:

- A bakery using modulation compressors installed a flow meter to determine system flow. After data logging, the system was determined to be operating at a level of 50 kW/100 cfm. The compressors are rated at 18 kW/100 cfm at the current system pressure. The site did not previously monitor power or flow.
- A large mine in northern Manitoba was running a 7,000 cfm 1,750 hp compressor in blow-off mode. Flow meter readings showed the mine flow was actually consuming 3,000 cfm, yet data logging showed compressor was drawing near full load power. The excess air was being blown off to atmosphere. Compressor power consumption was about 12,000,000 kWh per year. Specific power for this system was 46 kW/100 cfm. The system was replaced by four large screw compressors with sequencing control with a 7,000,000 kWh per year reduction in energy consumption resulting in a $190,000 per year savings. Site previously measured flow but not power.
- A large aerospace facility is using two large 350 hp centrifugal compressors running in modulation. Flow meter readings showed the actual average plant flow was 795 cfm. The excess was being blown off to atmosphere. Compressed air power consumption was about 4,855,000 kWh costing $189,400 per year. Average specific power for this system is 70 kW/100 cfm. Site does not measure flow or power. An efficiency project is pending.
- A large hospital was using one large 175 hp centrifugal running in modulation. Site flow meter readings showed the actual average flow was 205 cfm. The excess was being recycled to the inlet of the compressor. Compressed air power consumption was about 1,328,000 kWh costing $64,000 per year. Specific power for this system is 74 kW/100 cfm. The site previously measured flow but did not monitor power. A VSD compressor was installed and saved 56% or $37,000 per year.

While the CASE Index uses SCF (standard cubic feet) per kWh (kilowatt hour), Manitoba Hydro decided to use kW per 100 cfm as an index for efficiency monitoring. This is the same index used by the Compressed Air and Gas Institute (CAGI) for measuring air compressor and dryer efficiencies. The CAGI specifications for a wide range of new compressors and dryers are readily available on the websites of most suppliers. It was felt that this index would be simpler to use as unit of comparison and would be easier to compare with this published CAGI data.

We have had good success with four permanent experimental installations to date with two more nearing the commissioning phase. This type of installation is very useful in our measurement and verification efforts for very large efficiency projects and goes a long way to ensure the sustainability of the savings in these systems.

Conclusions

Air system monitoring is very important as an awareness and enabling tool for system users. Our experience suggests flow metering is a very important part in providing accurate system monitoring, which directly leads to higher quality options for system improvements and greater confidence in the potential project results. It should also be emphasized that flow metering is meant to compliment amp, power and pressure readings, not replace them. The advent of low cost flow metering and affordable and flexible power metering is making this type of monitoring more economical for permanent installations. The use of this data is often very revealing, and an eye opening experience for system owners and operators. In our experience the key to successfully optimizing your system begins with knowing your system. BP

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COMPRESSED AIR SUPPLY EFFICENCY

BY BABU JOSEPH, PH.D., P.E., SOUTHERN CALIFORNIA EDISON

Abstract

This project, under contract from California Energy Commission, developed the CASE (Compressed Air Supply Efficiency) Index as a stand-alone value for compressor central plant efficiency. This Index captures the overall efficiency of a compressed air system's supply side under typical plant operating conditions. Essentially, the index is a ratio of Standard Cubic Feet (scf) of compressed air supplied by the central plant to the total number of kWh supplied over a given cycle period. The index can therefore be considered as a true output over input metric that measures the general performance of the supply side of a compressed air system in a similar way that the Miles Per Gallon (mpg) figure measures a vehicle's efficiency.

CASE Index has the units of Standard Cubic Feet (scf) per kWh. It has a potential range of 0 to 325. Higher indices represent better efficiencies.

Five on-site tests were conducted on compressed air systems in various manufacturing plants. The sites varied in size from 75 to 650 horsepower. CASE Indices at these sites varied from 128 to 245.

Background

Industry sources estimate the total connected load for compressed air in the US is over 17 million horsepower. For most industrial facilities, compressed air is a necessary part of the manufacturing operation. Generating compressed air is an energy intensive process, and for majority of industrial operations, the energy cost fraction of compressed air is significant in comparison to their overall energy costs. Yet there is a vacuum of reliable information on the energy efficiency of a typical compressed air system.

In industrial sites air compressors with auxiliary equipments like dryers, filters, etc., are usually located in a central place, and this area is called the compressed air central plant. The overall energy efficiency of the compressed air system is greatly affected by the full load and part load compressor efficiencies, the control system that operates and sequences the compressors, and various other equipments in the central plant. The full load efficiencies of compressors are well quantified and understood by the operators. But the other factors that significantly affect the overall efficiency are not quantified and are vaguely understood by the operators. As result of all these, the true efficiency of the total system is often very low. To make things even worse, there is no metric available at this time to benchmark the system performance and to track future improvements.

This project aimed at developing an acceptable form of metric with procedure to address this issue.

COMPRESSED AIR SUPPLY EFFICENCY

Benefits of Case Index

Developing an acceptable procedure to determine the system efficiency will have several benefits to the customer and the industry as a whole.

- Compressed air system operators will have an accepted procedure to assess their system performance and compare it against others.
- System operators will have a tool for monitoring the system performance on a real time basis, and set trigger points for intervention. It will prevent drastic losses of efficiency due to control failures and other reasons. Such failures are commonplace for compressor systems.
- The CASE Index will provide a way to quantify energy savings from system improvements, and thus facilitate system improvement projects. It will lead to energy savings.
- This will provide an acceptable metric for energy efficiency program development and administration of rebate programs.
- System efficiencies will be quantified and benchmarked on many systems. It will lead to statistical graphs with mean, median, and such statistics, on compressed air central plants. This will facilitate monitoring of efficiencies for regulatory and governmental agencies at local, state, and federal levels.

These benefits were well understood by the compressed air industry experts in Southern California from the outset. Their enthusiastic support to Southern California Edison Company by way of lending equipment, site selection, and technical advice, made this project a success.

Project Steps

Determination of CASE Index involves metering energy (kWh) flowing into and the compressed air (scfm) flowing out of the central plant. Metering kWh is routine, and does not involve complications. But metering compressed air flow is a different case. Reliability of flow data was recognized to be a major problem from the beginning. So the project was essentially divided into two parts:

- Evaluation and assessment of accuracy of various compressed air flow measurement devices.
- On site testing of selected metering systems and developing the CASE Index. Five test sites were completed so far.

Evaluation and Assessment of Flow Metering

Following is a brief summary of available flow meters and their reliability issues:

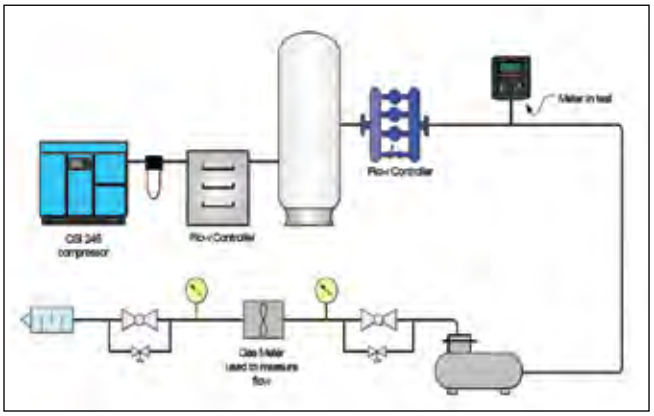


Figure 1. Test Bench

- Inferential Mass Flow Meters

1. Orifice plate
   - Turn down ratio: 10 : 1
   - Piping Modifications
   - System Shut down
   - **Flow obstruction**
   - **Permanent Pressure Loss**
   - **Crud build-up**

2. Venturi tube
   - Same as above

3. Pitot tube
   - Hot tap possible
   - Strict range limitations, Reynolds Number 200+
   - **Interference of particles, water droplets, etc.**
   - **Frequent cleaning and calibration**

4. Magnetic Flow Meters
   - EMF proportional to fluid flow
   - Does not work for Compressed air due to **Conductivity of air**

5. Positive Displacement Flow Meters
   - Impeller, rotating discs, sliding vanes, turbine, etc.
   - Turn down ratio: 10:1 or may be 20:1
   - **Sensitive to contamination of bearings**

- Direct Mass Flow Meters

1. Constant Temp. TMF
   - Eldridge Products, Inc.
   - 2 Platinum RTDs
   - Turn Down Ratio: 1000:1
   - Fast Response
   - **Sensitive to Water droplets**

2. Constant Power TMF
   - Turn down ratio: 100:1
   - Three RTDs
   - **Slow Response**

An advisory panel consisting of industry experts recommended insertion type direct mass flow meters only for evaluation. Other types of flow meters were ruled out due to the issues presented above.

Even among the Mass Flow meters, accuracy and reliability were of concern. So test facility was set up in the SCE laboratory to evaluate flow meters selected by the advisory panel. The test set up is shown below:

Flow meters from Eldridge, Fluid Components International, Sierra Instruments and Trak Air, were evaluated in the SCE Laboratory against a positive displacement control flow meter, Aerzna DN 65.

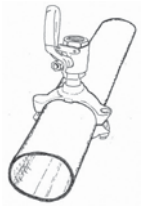


Figure 2. Hot Tap for Flow Meter

Results from these tests are summarized and presented in the graph below:

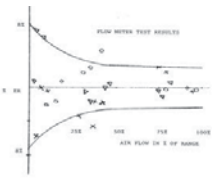


Figure 3. Flow Meter Test Results

X Axis — % Full Scale	1. Eldridge	8240MPNH
Y Axis — % Error	2. FCI	ST 98
	3. Sierra	640S-M8
	4. Trak Air	

Initial compressed air flow metering efforts resulted in about 65% failure rate, in spite of strict adherence of calibrations and procedures recommended by the flow meter manufacturers. Human errors at the testing and calibration laboratories were the reasons for the failures in all but one case. The graph presented above, represents the data after the corrections were made. Subsequent efforts to avoid the human errors have yielded an almost 100% success rate to date.

On Site Testing

The second step in this project was to test the procedure on working compressor systems. Five systems, varying in size from 75 to 650 hp, were studied in an effort to fine tune the procedure and to work out any problems related to installations and metering, and to develop overall familiarity with the metering equipment and mounting. A schematic of the equipment and metering devices is presented below for one of the five systems that was studied.

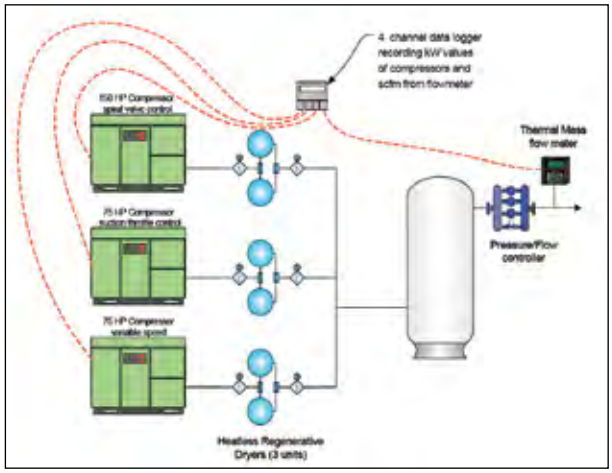


Figure 4. Compressor System for Site # 3

In the procedure developed, compressed air flow rate is sampled four times per minute (once every 15 seconds) and the average of the four samples is recorded on a data logger every minute for an entire week. Energy supplied to compressors and other auxiliary

COMPRESSED AIR SUPPLY EFFICENCY

equipments are also metered and recorded on the same time interval. All metering points are time synchronized to aid in the analysis and diagnosis of problems. The program calculates the index minute by minute, and prints it along with the scfm, and the total and individual kWh consumed. The CASE Index will vary between 0 and about 325. Higher numbers indicate better efficiencies. The average CASE Index for the entire week is calculated, and that becomes the efficiency statistic for the system.

In the case presented above the compressors were rotary screw air compressors (75hp and 150hp). The two 75 hp compressors supported the plant, and the 150 hp was a stand-by for service. The maximum CASE Index potential for this system is around 293 (scf/kWh). The actual performance turned out to be 193. Considering the system set up with VSD compressor for trimming, the actual performance (CASE Index of 193), was way below that was expected. The results immediately indicated a need for a better sequencing control. In this case, the engineers in this plant set up a new controller with a PLC that operated based on the data coming from the flow meter.

Results

Results from the five on site tests are summarized below.

Table 1. Summary of On Site Test Results

SITE #	HP	CASE INDEX	CASE IND (MAX)	REMARKS
1	75 30+30+15	128	300	Many improvement opportunities. Financially not justifiable due to small system size
2	300 150+75+75	193	293	New controller for sequencing. **122,500 kWh annually**
3	650 4x125+150	215	300	Suspected solenoid malfunction. Being traced. Energy impact unknown.
4	600 4x150	243	312	Replace QSI490 with 150 HP VSD compressor. **617,000 kWh annually.**
5	130 2x40+2x25	241	286	Replace all four with 100 HP VSD unit. **88,000 kWh annually**

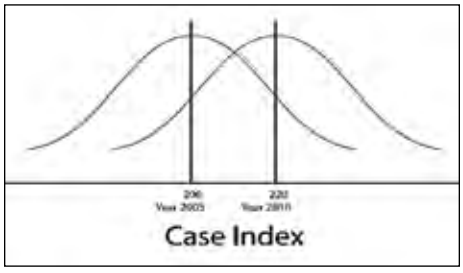
Typical Report

The study issues a final report on the system performance with a Summary Section and the Data File. The Data File contains about 12,000 individual lines of data. The Summary Section and a brief portion of the Data File for one of the sites are below.

Future Studies

This is a very useful tool for benchmarking compressor system efficiencies. Many companies have multiple plants, and would want to have a benchmarking tool to document, compare and track system efficiencies for various plants within the corporation. In the studies presented above, site #2 and #5 belong to the same corporation. After the first study, engineers for this corporation recognized this as a benchmarking tool, and are now involved in studying the compressor systems in several plants.

Utilities and regulatory agencies could quantify system efficiencies and develop statistical histograms for a geographical area and track progress of energy efficiency efforts. If the histogram in 2005 yields an average CASE Index of 200, and a similar curve yields 220 in year 2010, the progress in the five year period can be claimed to be 20 CASE Index points or 10% for the area.



Compressed Air System Efficiency

CASE Index — XXX Irvine

Summary Of Results

- Average CASE Index was 193
- CASE Index ranges was from 58 to 286
- This was the result of a one week study — 2/12/03 to 2/19/03
- CASE Index measures the overall efficiency of the compressed air system. Higher number indicates higher efficiency. Improvement of 10 units in CASE Index is equal to saving 35,000 hWh a year for this installation.

Two strategies to improve the Index without much capital investment:

1. Shut down the Base Compressor from 1.15 A.M. to 4.45 A.M.

   Estimated new CASE Index: 210
   17 Index points improvement — 59,500 hWh/Year savings

2. Use the flow meter to shut down Base Compressor at 220 scfm and restart at 280 scfm.

   Estimated new CASE Index: 228
   35 Index points improvement — 122,500 kWh/Year savings

XXX Irvine could install a 100 hp compressor with VSD. This would be sufficient to supply the plant 24 hours a day, and will improve the CASE Index even higher.

Figure 5. Summary of Report

Table 2. Data File

DATE/TIME	NORTH QSI 490 KW	NORTH QSI 500 KW	NORTH FLOW SCFM	SOUTH QSI 500 KW	SOUTH QSI 500 KW	SOUTH FLOW SCFM	TOTAL FLOW SCFM	TOTAL KW	CASE INDEX
9/11/03 12:00 P.M.	90.82	91.66	613.4	73.62	77.88	676.9	1290.4	333.98	**231.82**
9/11/03 12:01 P.M.	90.97	91.89	624.8	75.98	76.97	661.1	1285.9	335.81	**229.76**
9/11/03 12:02 P.M.	90.75	91.89	637.6	77.80	77.04	657.0	1294.6	337.48	**230.16**
9/11/03 12:03 P.M.	90.67	91.89	622.6	76.21	76.74	647.6	1270.2	335.50	**227.16**
9/11/03 12:04 P.M.	90.29	91.89	631.8	74.53	76.21	628.7	1260.5	332.91	**227.18**
9/11/03 12:05 P.M.	89.91	91.66	622.3	74.61	76.05	627.6	1249.9	332.23	**225.74**
9/11/03 12:06 P.M.	89.68	91.20	613.4	74.68	76.51	632.5	1245.9	332.08	**225.12**
9/11/03 12:07 P.M.	89.91	91.36	616.8	74.91	76.66	631.0	1247.8	332.84	**224.94**
9/11/03 12:08 P.M.	89.83	91.13	629.0	74.53	76.66	641.9	1271.0	332.15	**229.59**
9/11/03 12:09 P.M.	90.52	91.43	644.0	74.99	77.12	659.6	1303.7	334.06	**234.15**
9/11/03 12:10 P.M.	90.75	91.81	641.0	76.74	77.12	664.5	1305.5	336.42	**232.84**
9/18/03 11:59 A.M.	0.00	90.59	413.8	89.07	87.70	888.2	1302.0	267.37	**292.19**
9/18/03 12:00 P.M.	0.00	90.44	415.0	88.77	87.09	892.0	1307.0	266.30	**294.48**
Averages	**640.0**						**1391.4**	**344.25**	**243.11**

Acknowledgements

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I wish to thank Mr. Pramod Kulkarni and Mr. Rajesh Kapoor of CEC for their unwavering support to this project. I like to express my gratitude to Mr. Frank Moskowitz of Draw Professional Services, whose efforts and dedication to this project made it a success. I also want to thank the industry experts from Southern California who served in the advisory panel for their time, advice and support. BP

For more information please contact Babu Joseph, Senior Engineer, Southern California Edison, email: Market.Joseph@sce.com, tel: 626-633-7177

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Ecos Air:
Managing Incentive Programs

Compressed Air Best Practices™ spoke with Mike Bailey (Senior Engineer) and Brian Setness (Program Administrator) of Ecos Consulting.

Good afternoon. Please tell us about Ecos Consulting.

Good afternoon. Ecos is a 15-year old consulting company driven to provide solutions for clients to manage their carbon emissions, implement environmentally sustainable practices and reduce their energy use. We are a privately held company with 125 employees. Our headquarters is in Portland, and we have offices in Seattle, San Francisco, Durango (Colorado) and Las Vegas. Plans are also underway to open an office in Texas to support our field staff there.

How is business?

Demand from corporate America and from utility companies has been very strong over the past year. Corporate America has developed "Go Green" strategies and we find demand for all our services is increasing. Utility companies are hiring us to implement and execute their energy efficiency incentive programs. We have added 30 employees over the past seven months and are interviewing many more. Staffing is our primary challenge right now. Demand is exceeding supply right now.

How do you manage carbon emissions for clients?

Coca Cola and Yellowstone have hired us to assess their greenhouse gas (GHG) inventories and provide management plans to reduce their carbon footprints. Our engineers work with companies like these to create baseline and current-year emissions profiles. The deliverable is the creation of a Climate Action Plan™ identifying methods for GHG reduction, their impact and costs. The group can also develop onsite energy generation capabilities for customers for sub 10 MW projects — including renewable energy development opportunities.

Carbon mitigation is an opportunity we pursue with some clients. Methane-recovery projects, landfills and/or agricultural operations are also some examples. We also do project development and management of forest sequestration and soil recovery projects.

What does your "Sustainability Solutions" group do?

This group addresses many areas. One is to identify new heating, cooling and energy sources. New sources can include renewable generation like combined heat and power (CHP) and solar. The industrial use of water is managed by this group. Analysis of water consumption in heating and cooling applications is done and water conservation opportunities are identified. Wastewater and treatment load assessments are also done by this group. They also will identify potential water pollution sources.

Waste and recycling is another area of expertise. We do analysis of disposal means and costs. Ecos will develop a program to reduce waste stream and increase recycling rates. Finally this group helps companies develop sustainable action plans.

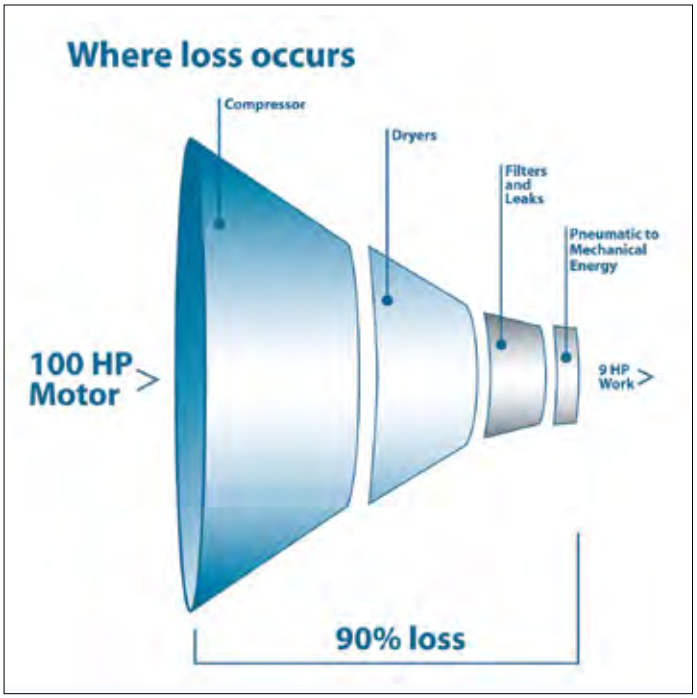
Last but not least please describe your Energy Efficiency Solutions Group.

The company started with optimizing lighting efficiencies in residential. We then moved into all kinds of industrial processes including lighting, pumps, controls, motors and HVAC systems. Compressed air has become a significant portion of our energy-efficiency auditing activity and a segment we expect to grow under the "Ecos Air" name.

What does Ecos Air specialize in?

Ecos Air is a third party contractor hired by utility companies to implement their efficiency incentive programs. Ecos works with utilities like PG&E, San Diego Gas & Electric and Southern California Edison.

Many utilities find it challenging to implement an industrial incentive program aimed at reducing energy consumption. What forms should they require business owners to fill out? Why do they sometimes get poor program participation? How do they verify that energy savings are attained? Ecos Air has a program where the utility company just has to establish a financial budget and we execute the projects and guarantee the energy savings.



How does the program you administer for Pacific Gas & Electric (PG&E) work?

PG&E has a very well developed industrial energy efficiency incentive program which is financed and staffed very progressively. They are truly proactive about pursuing energy efficiency in Northern California. They have a large incentive budget, which they administer and manage with their own staff.

Our role with PG&E is to work with a set group of industrial customers with a separate budget for incentives. We provide:

1. A walk-through audit at no charge
2. The client then fills in our three-page application. This reserves incentive money that is projected
3. We manage a 7–10 day audit capturing this many days of data logging. We try to have at least one weekend of data captured during the audit. We either do the audit ourselves or will work with a vendor to do the work
4. We measure pressure, flow and kW to establish our baseline parameters
5. We have a third party vendor do post-project verification of the savings. We only get paid by PG&E if the projected energy efficiencies which they financed are confirmed
6. We are vendor neutral as to what equipment should be installed

What recommendations do you have for end users?

Don't make any assumptions. Our customers are always surprised at what is discovered about their compressed air consumption. Quick conclusions or "quick audits" can lead to false conclusions. We recently had a customer who said that his facility was completely down on the weekends. Our data logging, however, showed significant air consumption. It turned out some employees were showing up and working on their boat trailers all weekend!

What incentive does PG&E offer?

PG&E offers (through our Ecos Air program) a 10-cent per kilowatt-hour incentive up to 70% of the total project cost including installation. We are managing a $2 million incentive budget for PG&E over a three-year period. The incentive is paid upon completion of the project. The client must come up with the capital beforehand. Sometimes this is not budgeted by the client and this can be an obstacle. Going outside of their planned business capital processes can be a challenge. We are finding some equipment vendors willing to offer these clients extended payment terms allowing time for the incentive funds to arrive.

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ECOS AIR: MANAGING INCENTIVE PROGRAMS

How long will PG&E keep focusing on compressed air?

PG&E's internal program provides incentives of eight cents per kilowatt-hour for up to 50% of the project cost of financing. Their overall incentive budget for industrial processes is probably around $100 million.

We don't know how long the utilities will continue to focus on compressed air. We have found that where there are inexpensive energy savings to be had, they will focus on those areas. Compressed air remains an area with great opportunities.

Some utilities have said they won't give an incentive forever because it will no longer be an incentive. They want to work with leaders in industries who other companies will emulate. They also want to avoid "Free-Ridership" by providing incentives for things not currently identified as normal business procedures. They want to incentivize a company to enact an energy-saving program which they would not have otherwise done. When doing compressed air efficiency projects becomes a normal part of doing business in an industry or region, the utility will move on to other priorities.

Do Leak Audits receive incentive monies?

No. PG&E considers managing compressed air leaks as a normal part of doing business. They therefore do not provide incentive capital for this part of improving a compressed air system. They view air leaks as a regular plant maintenance item.

We were in a plant recently that produces one million eyeglasses per month. We couldn't hear each other talk because one machine was hissing so loudly with a compressed air leak. We put a valve on it and fixed it. Leaks are certainly still a major issue.

Who does the implementation side of your Audits?

We can do all the project management, schedule updates and vendor delivery updates if requested. Some factories are too busy to do the project management while others have engineering departments that want to manage the project themselves. We leave that up to the customer although we certainly are there for all implementation steps and sometimes we do it. We do it in smaller plants, bigger plants do it themselves (70-30 towards big plants doing it themselves). We do schedule tracking.

The Verification Audit is done when equipment has been installed for two weeks. We data log for at least a week (7–14 days) and provide information back and compare actual to the baseline. We protect the client and PG&E. If we promise a $100,000 savings on a 1 million kWh savings and only deliver $80,000 — then we lose the $20,000 since our incentive is guaranteed based on upfront projected amounts. We honor the amount so there is no guessing on the incentive for our customer. It enables their budget to stand solid and not be under funded at the end of the project. Our customers deserve to know what they are getting upfront and we guarantee it in writing.

What is the Ecos Air business growth model?

We are speaking with many utility companies around the country who are looking to us to administer their upcoming (or future planned) energy-efficiency incentive budgets. We provide a pay-for-performance model and a turnkey implementation program like we do for PG&E. BP

Thank you Ecos Air for your insights.

For more information, please contact Brian Setness, Industrial Efficiency, Ecos Air, tel: 503-525-2700 x152 or email: bsetness@ecosconsulting.com or Michael Bailey, Senior Engineer, Ecos Air, tel: 503-525-2700 or email: mbailey@ecosconsulting.com

"We provide a pay-for-performance model and a turnkey implementation program like we do for PG&E."

Kaeser Compressors: Loyalty, Energy and Growth

Compressed Air Best Practices™ interviewed President Reiner Mueller and Executive Vice President and General Manager Frank Mueller of Kaeser Compressors, Inc. for a look back at their first 25 years in the US as well as their outlook for the future.

Good afternoon. Last year you celebrated 25 years in the United States and you have announced your retirement as President at the end of this year. Can you summarize Kaeser's position in the face of these two important milestones?

Reiner Mueller: Reflecting on our first 25 years, it's clear that Kaeser Compressors has accomplished a great deal thanks to the hard work and loyalty of many people. Our owners, employees, distributors, customers and vendors have all played a vital role. Even more rewarding for us as a company — and for me personally — is the number of employees who have worked with us for many of those years. By focusing on a single purpose — serving the customer with the best products and solutions — we have achieved what many thought impossible. I am grateful to have been a part of that success.

Now we stand at the dawning of a new day. We face new challenges in growing markets and a changing economy. It is the ideal time for renewed energy and new leadership from a new generation.

Frank Mueller and Reiner Mueller (left to right) of Kaeser Compressors, Inc.

What role did the Kaeser family play in Kaeser's growth here?

I first met Mr. Carl Kaeser in the late 1970's while I was running a 200-employee manufacturing facility for KSB pump and valve in Tehran. By 1982, Khomeini's revolution was three years old and I had returned to Germany. At the time, KSB had 15,000 employees and was the world's largest pump manufacturer.

Mr. Kaeser was looking for an energetic, loyal manager to establish Kaeser Compressors in the United States. Although Kaeser Germany only had a few hundred employees at that time, they already had an impeccable reputation for financial stability and superior quality. We both felt Kaeser had excellent potential for success in the U.S. I was ready for a new challenge and with the support of my family, accepted the opportunity.

The Kaeser family has always supported the US 100%. I can recall a time when Mr. Carl Kaeser would be reading until 2 a.m. every day. There were many times when I called and interrupted his reading to say that we had a special requirement or an urgent deadline and had to have a particular compressor built right away. He always replied that he would go to the factory floor the next morning and personally make sure we got what we needed.

What were the first few years like for Kaeser?

We chose Fredericksburg, Virginia as our US headquarters due to the proximity of four major airports, three container ports and a major interstate for trucking. We started with a 10,000 square foot warehouse and four employees — including me. We had a serviceman, a secretary and a lone salesman — Roy Stuhlman. He is still with us today as our Vice President of Sales — as are many of the loyal distributors he recruited for us in those early years.

At the time, rotary screws were just really getting started in the U.S. The horsepower sizes being sold were primarily 25–100 hp. People understood that rotary screw compressors were constant-duty machines with lower maintenance costs than the larger piston compressors. It was the beginning of a tremendous growth pattern for the rotary screw market across the world, but some education was still needed on how to most efficiently apply this technology.

How did you build Kaeser?

We always had an outstanding product. You start with that and much like today, you focus on educating the customer and training field sales engineers. We had the right ideas on serving customers — and we had the time to do things right as well.

With those fundamentals in place, we put in a lot of hard work. The first year in the U.S., I drove over 72,000 miles. We kept our expenses low and as a result, we made money in just our second year of operation. All of our employees were then and are now completely focused and committed to building Kaeser.

Kaeser Compressors Headquarters in Fredericksburg, Virginia

How did Kaeser position itself in the market during the 1980s?

In Europe, there was a great deal of focus on energy efficiency. Kaeser Compressors established itself as a leader by developing the proprietary Sigma Profile air-end. It has a significant design advantage allowing it to produce 20% more air per horsepower than comparable designs. We carried that message through in establishing our business here. Even today, our research, development and design teams continue to optimize the design for even greater performance and the Sigma Profile remains the heart of every Kaeser compressor.

The Kaeser Sigma Profile

One of the first things we did was test several competitive units, and we challenged a number of companies to compare energy efficiency. Some manufacturers took up the challenge — those who did not know their own efficiency numbers. Some did not — generally those that did know. It created quite a stir!

Kaeser has also expanded in Canada and Latin America — correct?

Yes. Kaeser has grown steadily in both Mexico and Canada since the late 1980s and early 1990s. Both countries have their own subsidiaries with extensive warehousing, sales and service operations.

During the early 1990s, Frank Mueller joined us and together we began establishing our presence in Latin America. Over the years, we built successful subsidiaries in Argentina, Brazil, Chile, Colombia, El Salvador, Guatemala and Honduras. We have also built strong distributor organizations in most countries in the Southern Hemisphere.

KAESER COMPRESSORS: LOYALTY, ENERGY AND GROWTH

Leadership Profile:

Name: Frank Mueller

Title: Executive Vice President & General Manager

Company: Kaeser Compressors, Inc.

Birthplace: Pegnitz, Germany

Education: A Degree in International Business, European Business School (EBS) in Wiesbaden, Germany

Career: GM Brewery Operation, West Africa
GM Kaeser Latin America, Chile
GM Kaeser USA, Fredericksburg

Hobbies: Reading, traveling, golf

Favorite Business Book: "Porsche's Customer Value Philosophy" and "The Blue Ocean Strategy"

Favorite Movie: Young Frankenstein

Frank Mueller of Kaeser Compressors

Now looking forward, how is Kaeser positioning itself in the "Green" marketplace?

Frank Mueller: We're very encouraged by the economy's new found commitment to being "green." It's a philosophy we adopted long ago. We have not only offered the most energy efficient solutions for decades, but we implemented an ISO 14001:2004 Environmental System in 1999. This isn't jumping on the bandwagon for us — it's how we've always conducted business.

As a result, we continue our commitment to educating end-users — whether or not they are Kaeser customers — on how to optimize their compressed air systems. Kaeser specializes in individually evaluating each customer's compressed air application and providing the most efficient and value-based air system. We go to great lengths to truly customize a system which fits their needs — not just sell them a new piece of equipment.

Kaeser has developed tools like the Kaeser Energy Savings System (KESS) which simulates various demand scenarios a customer may experience. KESS allows customers to see what their energy costs will be with alternative compressed air systems. Customers like getting involved in saving energy and this tool enables them to become a partner in choosing their solution.

Is Kaeser involved with auditing?

Absolutely. Our Systems Engineering group, lead by our Technical Director Wayne Perry, is actively engaged with comprehensive demand-side and supply-side audits across the country. Our exclusive Air Demand Analysis (ADA) program measures and baselines a compressed air system's actual power consumption and compressed air usage. We also train Kaeser Distributors to conduct audits and provide customers with ADA profiles. Because these detailed, time-stamped charts are based on the recorded data, end-users can visualize their system and it can be analyzed from several perspectives.

Kaeser's commitment to auditing and providing the most energy efficient systems is underscored by our membership and participation in the Compressed Air & Gas Institute (CAGI). In fact, Wayne Perry is currently the Rotary Positive Section Chairman for CAGI. Mr. Perry also serves as a consultant to the United Nations Industrial Development Organization and the United States Department of Energy, is a member of both ASME and ISO TC118 Working Group to develop ANSI and international standards for compressed air assessments. His work on these important initiatives help us promote industry-wide efforts to educate individual end-users, improve energy efficiency on a global scale and serve our common goal of effectively applied compressed air systems.

Hasn't Kaeser invested a lot in compressor controllers?

Comprehensive system controls is the area with the most potential for energy savings. End-users can save thousands of dollars annually in utility costs — and in today's competitive environment that's money no one can afford to leave on the table.

But rather than requiring expensive, one-of-a-kind and custom-programmed control systems, Kaeser was the first company to offer an off-the-shelf master air system controller. Our Sigma Air Manager (SAM) monitors and controls up to 16 air compressors plus system accessories. SAM balances service hours, prevents simultaneous motor starts and, unlike cascade sequencers, maintains tight pressure control for great energy savings.

The Kaeser Sigma Air Manager

Why are Kaeser products so well received?

As a company, Kaeser invests a great deal of research to develop features which help customers — and we are often "ahead of the market." In the 1980s, we offered features some of our competitors have just recently introduced. These traditional "Kaeser product features" include TEFC motors, standard sound-attenuating enclosures, pre-filtration, Wye-delta starters, belt-drives with automatic belt-tensioners, rubber feet, vibration isolators, floor panels — the list goes on and on.

Our attention to detail and global standardization on equipment that brings value has really made the difference. Today, Kaeser is leading the way with true direct drive machines — not gear drives — all the way down to 25 hp. These one-to-one drives give our customers an extra efficiency in each machine. We were on the leading edge in units with space-saving integrated air dryers and variable speed drive units as well.

What are some challenges facing Kaeser?

Fortunately, the challenges we face are the ones businesses want to have. Now that we are successfully established in the Western Hemisphere, we must continue to offer all customers the same level of service and professionalism they have come to expect from Kaeser, and we must provide the same level of service in all markets.

When we invoice or quote a customer, it must be in a consistent manner. A large corporate account wants to see the same kind of detailed invoice in Miami as they do in Georgia. In the early 1990s, we invested in a comprehensive SAP system which allows quotes to be built into orders and factored into inventory management. This decision not only played a large role in helping us manage our growth successfully, it is the backbone of our ongoing efforts to standardize operations worldwide.

What kind of people does Kaeser hire?

Kaeser employees are smart, hard-working and loyal. We place the highest priority on hiring the right people and doing everything we can in the interview process to make sure we have the right person for the job. It doesn't help to have a good product and the right strategy if you don't have the right people.

Education is important, but education levels are usually pretty similar. Between the two of us, we have personally interviewed every manager who works at Kaeser because it's often more of an intuitive feeling. How do you feel when you interview them? What do they bring to the table? We listen to what they say about teamwork experience — about loyalty. How do they talk about their family or their prior job? We look for longevity and consistency and people who portray persistence. Can we see them working for us 20 years from now?

We recruit people who have the mindset that if one works hard and the company does well, they will also be successful in the long run. That's how it is at Kaeser. That's the type of person we hire.

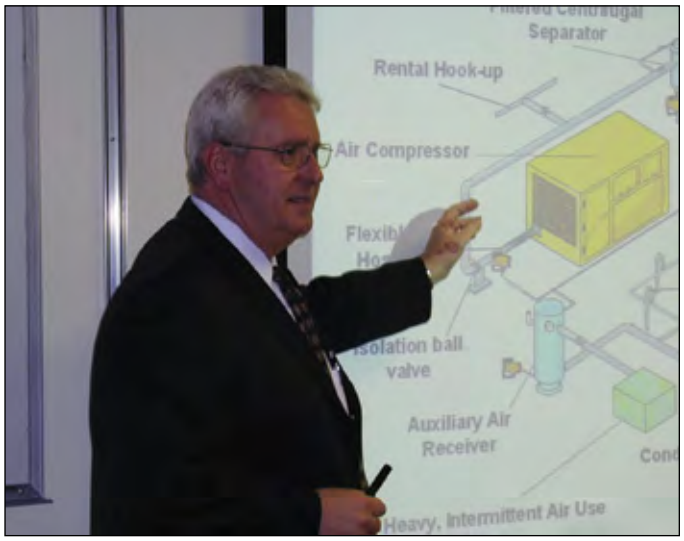
How has Kaeser built such a loyal organization?

While skills can be learned, loyalty cannot be taught. It must be earned. Kaeser has always been willing to hire young people, develop them and grow them in their career. We did this when we started the business and we do it today. This takes time and a lot of patience. It takes a lot of work from management as well and investments in training. The result, however, is our employees and distributors realize how important they are to us. Invariably the return on our investment is tremendous and a big part of that is loyalty.

KAESER COMPRESSORS: LOYALTY, ENERGY AND GROWTH

We remember how, in the early years, the competition grew very frustrated because they couldn't get any information on our equipment. They kept calling Kaeser Distributors who steadfastly refused to give them any information. They had never seen such loyalty in distribution before!

We are surrounded by customers, distributors, employees and vendors who have grown with us. They share our patience and long-term vision — and we in turn share their pride in their growth and success.



Roy Stuhlman, Kaeser Vice President of Sales

How would you describe the evolution of your distribution?

Finding distribution was one of our initial challenges. When we arrived, the established distributors were taken and had little interest in us because we couldn't give them any spare parts business.

We looked for enthusiastic and energetic businessmen like Richard Bishop at Dominion Air and Machinery and John Reinert at Delta Industries. We chose high caliber sales people with the desire to own a business, and we partnered with these entrepreneurs to build successful Kaeser distributorships. In the long run, we have gone further and faster than most thought possible because of our mutual commitment.

Today, we enjoy an extensive nationwide network of qualified, factory-trained distributors and representatives. While some have been with us from the beginning, other large established compressor distributors have recently joined the Kaeser network. Our goal is to provide every customer — and every potential customer — with the highest level of sales and after-sales service. We are here today because of our distribution network and they because of Kaeser. Once again, loyalty goes both ways.

What does Kaeser have to offer its distributors?

We want to be the best company in the world a distributor could represent. We work very hard at providing them the tools to be successful. We focus on product training, sales training and service training as well as training, training and more training! Our objective is to make sure any person representing Kaeser Compressors stands apart from the field in their ability to assist the customer in obtaining the right system for their needs.

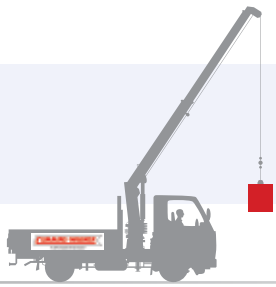
Several years ago, we formalized our training and created the Kaeser Factory Certified Training Program. We continue to raise the bar on what we require of our own employees and distributor employees. From product and sales training to specialized service seminars, we are committed to providing each Kaeser representative with a comprehensive set of tools and a solid knowledge base. This is our way of ensuring expertise at the highest levels through out the company.

What is a key attribute of a successful leader?

We know the first names of all our employees and we have open-door policies. We appreciate and enjoy our people, and I think they know that. If you enjoy people, they in turn will enjoy being with and working with you. We extend this to everyone we come into contact with: employees, vendors, customers, distributors — even those you encounter in every day life: the hotel lobby receptionist or rental car attendant. How you approach people is the way they see you. By recognizing the value of each individual and acknowledging contributions at every level, you build rapport. By being open and creating positive interactions, you empower people and encourage enthusiasm and good decision making. BP

Thank you for your insights.

For more information, please contact Kaeser Compressors, tel: 800-777-7873, email: info.usa@kaeser.com, www.kaeser.com



Building RELATIONSHIPS at Cummins-Wagner

BY COMPRESSED AIR BEST PRACTICES™

Compressed Air Best Practices™ spoke with Mark Shaffer (Compressed Air Product Specialist) from Cummins-Wagner Company, Inc.

Good morning. Please describe the Cummins-Wagner Company.

Good morning. Cummins-Wagner is a wholesale distributor of industrial process equipment and plumbing and heating equipment. The company is also engaged in the assembly and after-market repair and service of these products. We are active in the mid-Atlantic area, primarily Maryland, Virginia, Washington D.C., Delaware, central Pennsylvania and northeastern West Virginia.

We believe that our company has a unique ability to build long-term relationships with our customers, our vendors and with each employee-owner in our company. It is nurturing these relationships which has allowed us to just surpass $50 million in sales in the fiscal year that just ended — a growth rate of over 7% in the past year.

How would you describe the evolution of your distribution?

We think it plays a role. All 112 of us are employee-owners. Our employee-owners are extremely motivated and always take that extra step for our customers. We are an "ESOP" company with 100% of the common stock exclusively owned by the Employee Stock Ownership Trust (ESOT). The business was started, in 1960, by Mr. Charles Cummins and Mr. Charles Wagner. In 1985, following 25 years of stable growth and with a desire for business continuity for the benefit of all employees, both men sold their majority stock interest to the Cummins-Wagner ESOT. Both Mr. Cummins and Mr. Wagner continue to serve on our Board of Directors.

Please describe your relationships with your customers.

Cummins-Wagner places the highest value on our relationships with our customers. Our sales engineers/owners have an average tenure of 17 years with our company. That means we have an average of 17 years of relationship building with our customers. We are long-standing members in many engineering associations and have had a regular attendance over the years at dozens of area trade shows. Even with today's technology, people like to do business with people that they know, like and trust.

A unique attribute we have is our willingness to do engineering work for our customers. Ray Peloquin, an engineer and 30-year veteran employee, will do the engineering and CAD work for heat transfer, air compressors, blowers and pump systems. We will design and fabricate custom packages for customers. This saves them valuable installation and engineering time. We have four people dedicated to working with engineering firms. Richard Goins, the head of this group, has been with us for 30 years and belongs to all of the area engineering societies. These capabilities have helped us build very strong value-adding relationships.

Where are your operations?

We operate three facilities located in Maryland, Virginia and Pennsylvania. The Maryland (Annapolis Junction) operations are housed in a 31,000 square foot building owned by the company. It houses the corporate staff and supports the sales and service operations with a warehouse and full-service shop. The Virginia (Ashland) and Pennsylvania (Elizabethtown) facilities have 9,000 and 13,500 square feet respectively dedicated to office, warehousing and a service shop. We also have sales offices in Warrenton, Chesapeake and Winchester, Virginia and in Williamsport and Lansdowne, Pennsylvania.

BUILDING RELATIONSHIPS AT CUMMINS-WAGNER

The Cummins-Wagner Staff in Annapolis Junction, Maryland

The Cummins-Wagner Staff in Ashland, Virginia

The Cummins-Wagner Staff in Elizabethtown, Pennsylvania

Across the three facilities we deploy 23 fully equipped service trucks manned by factory-trained technicians, all on 24-hour call. We have invested heavily in our information technology tools as well. All locations are interconnected 24/7 into the same business management system. Remote or mobile users are equipped with laptops and can access the system via VPN or Citrix.

Has compressed air auditing helped your relationships with customers?

Auditing has enabled us to strengthen our relationships with our customers. Auditing has been a natural fit for us since we have always been more of a problem solver than a vendor to our customers. Since our sales-people/owners sell all of our products from pumps and blowers to heat transfer equipment and air compressors — we have a lot of areas we can help our customers with. We had a chemical processing customer, for example, with an ongoing problem with some mechanical seals lasting only months. We were able to design a sealing solution, which now lasts three years. This has saved them a significant amount of money.

When designing the solution to the mechanical seal problem, we were able to truly understand their downstream processes. When they wanted to review their compressed air systems, we were the natural choice due to our knowledge of their processes — even though we had not supplied the air compressors in the compressor room.

How do you go about doing audits?

We see a compressed air audit as a learning process. The customer and I embark upon a process together to learn how to save energy. I have found out that decision makers like to be involved in the process.

The most important first step is to help the customer realize that they need to measure and benchmark compressed air in order to improve. Without that, they just won't know. We are selling flow meters now to customers so they can measure and see what is happening every day. These meters come with software allowing the customer to tie into the clients Ethernet systems. Measuring air flow tells them what their demand is. This also allows them to see how much flow there is (leaks) when there is no production on weekends for example.

Usually the next step (after installing a flow meter) for the customer is to start a leak repair program. We schedule our audits to include a no-production day so we can accurately quantify leaks.

How do you measure a compressed air system?

Robert Schwarz and I conduct most of the compressed air system audits for the company. We normally begin with a supply-side audit. We feel that it is a good place to start the learning process.

Mark Shaffer, of Cummins-Wagner, monitoring compressed air flow during an audit.

We use a Sierra insertion-type mass flow meter (www.sierrainstruments.com) to measure compressed air flow. We usually install them on the main header pipe just after the clean up equipment and storage tank.

Amp meters are used to identify kW usage. Also used are data loggers supplied by ACR and pressure transducers on the compressor room header and also out in the plant. It is important to measure all the above variables to ensure you create an accurate supply-side profile.

We are looking at including equipment-independent dew point measurements (using our own instrumentation) as part of our audits in the near future.

How do you present the audit information to management?

Gardner Denver has been a tremendous resource to us when it comes to auditing. Mike Bakalyar and Paul Glace trained our auditors from day one and they have provided the process, tools and methodology required to execute successful audits. We use a report format that Gardner Denver (www.gardnerdenver.com) has prepared. It has an Excel workbook which takes the voluminous amount of info we compile from data logging the system and puts it into a concise 20-page report which can be presented to the customer. Summarized information gives averages for flow pressure and kW. We present system efficiency in cfm per kW. It also provides a two-page executive summary that shows decision-makers where they are now and where they could be by following best practices.

I have also learned to provide options and different scenarios. Each customer has different priorities depending upon where their company is at that specific moment. Rather than try to anticipate their priorities, we provide options.

We therefore offer three-to-four scenarios with different payback scenarios. Almost every system can be improved. Despite what you'd think, I have found some large corporations who won't approve a project with a 18-month payback. I have seen others choose a 30-month payback project over a 12-month payback because their corporation had just embarked upon a "Go Green" initiative and they wanted the higher energy savings numbers we could provide with a new variable speed drive air compressor and cycling refrigerated air dryer. Many of the quick payback options do not include new compressors and dryers but better system control. Each customer is different.

We are pleased to see more and more "Go Green" initiatives taking hold. Many corporations with multiple plants in North America are showing these types of initiatives.

Is Cummins-Wagner involved with blowers and vacuum pumps?

Yes, we started with these product lines in 1996 and have built it into a significant business for us. We represent the Gardner Denver Sutorbilt, CycloBlower and DuroFlow blowers and Elmo Rietschle vacuum. Rietschle is headquartered only 10 miles from our office in Maryland and it works out very well!

Auditing Training from Gardner Denver

Gardner Denver's Enhanced Services Program (ESP) provides training in the process and procedure for compressed air system evaluations. An emphasis is placed on ensuring an accurate base-case capture as well as reliable solution performance modeling. It is important that all project stake holders have confidence in the process and that the outcome is as promised. The training modules include:

- Data collection methods and controls
- Data handling and analysis tools
- "Dynamic Efficiency" (cfm/kW) as bench mark and management ratio
- Cost modeling of base-case and solution options
- Solution design selection and testing
- Application of configuration and automation tools
- Business case development
- Presentation
- Implementation
- Validation

For more information, contact Mike Bakalyar, Gardner Denver, tel: 217-222-5400 x7341, email: Mike.Bakalyar@gardnerdenver.com, www.gardnerdenver.com

GARDNER DENVER™

Experience Proven Results

BUILDING RELATIONSHIPS AT CUMMINS-WAGNER

Many corporations with multiple plants in North America are launching "Go Green" initiatives.

The Gardner Denver Rietschle Vane Pump has been strong for us. It has a superior compression chamber cooling design and five-year vane warranty although the vacuum industry is going towards dry claw technologies, which Rietschle also offers.

Blower and vacuum technologies help us conduct demand-side audits of compressed air systems. One of the most inappropriate uses of compressed air is free-blowing applications. We use positive displacement blowers to more efficiently get this work done for our customers — rather than regulating compressed air down from 100 psi to 15 psi!

Cummins-Wagner represents Gardner Denver air compressors and Gardner Denver Elmo Rietschle blower and vacuum technologies

Are there any energy efficiency rebates being offered by the utility companies in your area?

The Delaware "Energy Matters Program" set up by the state legislature just expired in April. They allocated $8 million for industry and consumers to implement energy saving technologies. Compressed air was a qualified target. It did not provide funds for efficiency projects with a simple paybacks of 18 months or less — the state felt that industry should do this on their own. It focused on projects with simple paybacks beyond 18 months — providing grant money up to $100,000 per facility to get the payback to the 18-month number. In Delaware, most power is controlled by the municipalities and power costs are around 13 cents a kilowatt hour. They did not do a good job advertising the program however.

Maryland is talking about a "Go Green" incentive program but nothing is in effect. We are not aware of any other incentive programs. The utilities our customers have include Dominion Power and PEPCO in Virginia, Constellation Energy in Maryland and PP&L and Allegheny Power in Pennsylvania. BP

Thank you for your time.

For more information, please contact Mark Shaffer, Cummins-Wagner, tel: 301-317-6230 x106, email: mshaffer@cummins-wagner.com, www.cummins-wagner.com

McIntire is Moving Forward

Compressed Air Best Practices™ interviewed Dan Keilitz (National Sales Manager) of McIntire Inc.

Good afternoon. What is new at McIntire?

Good afternoon. This is an exciting time at McIntire due to our investments in the industrial compressed air treatment business. The investments include a new cycling refrigerated air dryer line, a new non-cycling refrigerated air dryer line and a "next-day" delivery program nationwide.

Please describe the new cycling air dryer.

The new Eco Cycle™ cycling air dryer we introduced responds to the higher energy costs that our customers continue to experience. The cycling dryer has the capability of cycling the refrigeration compressor on and off in response to compressed air load conditions. When the facility is at no load or partial load during the second and third shifts, the refrigeration compressor will turn off and reduce the kW consumption of the machine. This is in contrast to a non-cycling design, which continues drawing 100% of power whether or not the factory is demanding compressed air.

McIntire's new Eco Cycle™ cycling air dryer.

The dryer is able to save energy due to the thermal mass system it deploys. The R-134a refrigerant cools the glycol/water thermal mass in the gasket-sealed media tank via a copper-coil heat exchanger. This thermal mass is cooled to 35 °F. The refrigeration system uses a direct expansion valve versus a capillary tube for more reliable performance. A hot-gas bypass valve is used to control refrigeration pressure and prevent freeze-ups.

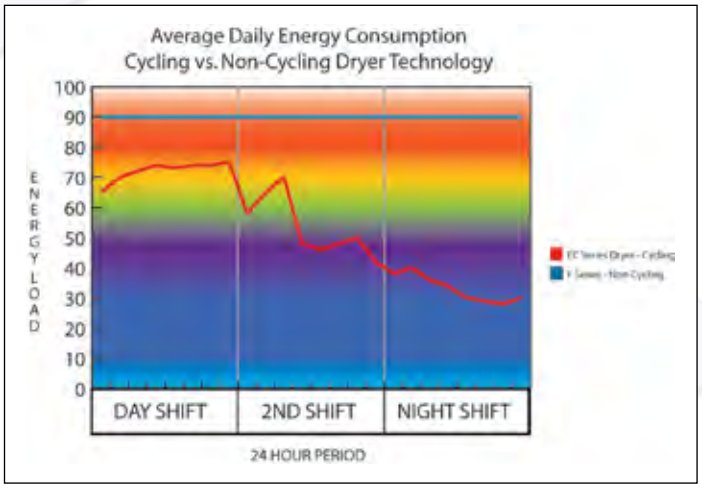
The compressed air enters the media tank and is cooled to dew point requirements in a second braze-plate stainless steel heat exchanger. Condensation of the moisture occurs in the compressed air stream as it cools and the droplets are removed by a sintered bronze filter element in the moisture separator.

Will the product qualify for energy rebates?

Yes. The design is the "cycling air dryer" technology which utility companies approve for their incentive programs. The reality of compressed air installations is that most systems are operating at partial loads. Most are not even operating during the third shift!

We have launched the first models ranging in size between 125 and 500 scfm. We are working on the next models, which will go to 1,000 scfm. Our longer-term plans are to offer Eco Cycle™ cycling air dryers through 2,000 scfm.

MCINTIRE IS MOVING FORWARD



Please describe the new non-cycling refrigerated air dryer.

The new Shop™ Series non-cyling refrigerated air dryers have been very successful for us. They have a rugged and robust design allowing for very high compressed air inlet temperatures to 176 °F (80 °C). The model sizes range from 40 to 325 scfm. The units offer a dew point range between 35 °F and 41 °F. The refrigeration system uses R-407c refrigerant and a hot-gas bypass valve for evaporator temperature control.

These dryers use larger stainless steel plate and frame design heat exchangers. All units are designed to ensure low pressure-drops across the system. All models are rated for a 4 psi or lower pressure-drop.

How does your "Next-Day" delivery program work?

Operations at McIntire has made a commitment to inventory which is a big plus for us and for our customers. The majority of our orders ship the next day. We are shipping 10 to 1,200 scfm air dryers next-day most of the time. This is for both our cycling and non-cycling refrigerated air dryers. This helps us serve customers who need a dryer right now due to a breakdown or a late purchasing decision! It is always very satisfying when we can save the day with a fast delivery.

The new Shop™ Series non-cycling refrigerated air dryers in production

We had a customer last week call for a 750 scfm non-cycling refrigerated dryer which he said the factory had to have next-day because their unit had failed. We shipped it as promised and the customer was so relieved/happy that they ordered a second 750 scfm dryer as a back-up! Some distributors carry large inventories of smaller-size dryers that they ship on a continual basis to their customers. We are also able to ship large quantities of smaller units next-day. This allows the stocking distributors to increase their inventory turns and reduce the cash they have tied up. The other day we shipped next-day 14 smaller-size refrigerated dryers to a stocking distributor. We also include our high inlet-temperature dryers in the program.

McIntire manufactures dryers in its 53,000 square foot facility built in 1999.

We are shipping next-day out of our 53,000 square foot manufacturing plant in Bristol, Connecticut. We have stocking locations in Florida, California, Texas and western Michigan. These remote locations keep a next-day inventory for models up to 500 scfm. BP

Thank you McIntire for your insights.

For more information, contact Dan Keilitz at tel: 860-543-4619, email: dkeilitz@mcintireco.com, www.mcintireco.com

THE 2008 A.I.C.D. MEETING

The Association of Independent Compressor Distributors (www.aicd.org) held their 23rd Annual Meeting & Exhibition, May 18–20, at Hilton Head Island in South Carolina. The educational focus of this organization continued to grow with a Speaker Program aimed at "improving the businesses and the bottom lines of our members," said **A.I.C.D. President Ron Nordby.** The event also held an exhibition where members are able to view new technologies.

The A.I.C.D. had a record number of exhibitors

The Speaker Program

Mr. Nordby said that the Speaker Program has improved over the years. "We used to hire one keynote speaker and then have the agenda dominated by a compressor vendor. Led by Mike Schmeltzer and John Zorn, we moved (in 1996) towards more of a educational focus and have been doing it ever since."

Bill Scales, CEO of Scales Air Compressor Corporation, was the Keynote Speaker with a speech titled "Finding the Will to Grow." With his experience in the compressed air industry since 1952 and history of having built his company from two people to 175 people — the audience was hanging on every word. When asked about the economy, Mr. Scales replied, "economists have predicted 12 of the past five recessions." Mr. Scales also encouraged the listeners to try things and not be afraid of making mistakes commenting, "waiting too long to make a change is the number one failure I have made." His action plans to grow a business do not dwell on elements beyond his companies' control (like the economy or the off-shoring of industry). Instead Mr. Scales encouraged the listeners to focus on ways to grow and provided a few suggestions including:

- Form alliances with other companies who service your prospective customers
- Identify your competitor's core accounts and make a plan to make them yours
- Explore new markets for your products: for example hospitals, temperature control for buildings, laboratories, utilities, commercial laundries
- Explore new technologies which improve your capabilities with your customers

THE 2008 A.I.C.D. MEETING

Bill Scales (center) was the Keynote Speaker

President Ron Nordby at the Exhibition (2nd from right)

Paul Johnson, Managing Director for Legris-Transair Americas and Asia, followed with a presentation on aluminum piping systems. He discussed how aluminum pipe has significantly grown its market share over the past 10 year by replacing copper and steel in industrial facilities. The benefits to the distributor and end user include reduced installation costs, reduced production downtime, ease of maintenance and the convenience of the "quick-connect" system. Many distributors who did not get involved in installations are now starting to offer turn-key installations to their customers.

Patrick Lorenz and **Ken Tier,** from the Rogers Machinery Company, discussed the Oil-Free compressed air market. An estimate of the market size was given along with a review of markets that have either specified "oil-free" air compressors or are strongly inclined towards this technology. These markets include petro-chem, electronics, hospitals, pharmaceuticals, power generation, universities, food and beverage, bio-tech and chemical. The presentation then made helpful suggestions as to proper system design.

Tony Hergert and **Craig Williams,** of Parker domnick hunter made interesting presentations respectively on the new ISO Filtration Standard and on nitrogen generation systems. Mr. Hergert pointed out that the new ISO 12500.1 Addendum to ISO 8573 is important in that it defines the "inlet challenge concentrations" to a compressed air filter, which is claiming to meet with a ISO 8573 Quality Class. The two challenge concentrations are:

- 40 ppm for 1–5 Micron
- 10 ppm for 0.01 ppm filters

Mr. Williams made an interesting review of the nitrogen gas generator market and how the A.I.C.D. Members can apply these products with their customers.

Dan Bott of Dan Bott Consulting made a very interesting presentation on the opportunities for auditing and selling vacuum systems. He recommended that A.I.C.D. members focus on the "Rough Vacuum" market, which is for applications ranging from atmospheric pressure to 29.88 HgV (inches of mercury). The applications are varied but can include the holding of wood, bulk handling, shaping/thermoforming, drying (pulling water off produce for example), printing and cooling. Food processing was identified as the largest Rough Vacuum market.

Tom Taranto of Data Power Services is one of the leading independent compressed air auditors in the U.S. He made a very interesting presentation to the A.I.C.D. Members encouraging them to focus their auditing efforts to:

1. Teach factories to produce their products while using less compressed air
2. Adjust the air compressors to cash in on reduced air use
3. Measure Flow as well as kW

He also went through a series of demand-side success stories that identified "Inappropriate Uses" of compressed air. The stories covered cabinet coolers, air-operated reciprocating pumps, air-powered shop vacuums, air motors driving ink pumps and air powered vacuum generators.

A Record Turnout for the Exhibition

An A.I.C.D.-record 53 exhibitors displayed their technologies and services in the spacious ballroom. This represented a 25% increase over the previous high for vendor participation. Consistent with prior years, decision-makers from 28 A.I.C.D. member companies from the U.S. and Canada visited the booths. The technologies on display included compressor controllers, air compressors, vacuum systems and instrumentation products.

Compressor controllers are in high demand today as auditing improvements on the demand side of a system require that air compressors be sequenced appropriately to capitalize on the efficiency gains. Vendors in this area included John Henry Foster Minnesota. Their air compressor control system has the ability to integrate both airflow and air pressure measurements for systems up to 30,000 cfm. I also found the Standard Pneumatics auto-dual controllers interesting and economically priced for smaller horsepower recip and screw compressor installations within the BelAir Technologies booth.

Booths featuring air compressors included oil-free centrifugals from FS Elliott, oil-free rotary screws from Rogers Machinery and oil-free screws and scrolls from Hitachi.

There were vacuum systems from Dekker, piping systems from Teseo and Transair and many compressed air treatment product vendors including Numatics Ultra-Air, Jorc Industries and the differentiated Parker brands of domnick hunter, Airtek, Zander and Finite.

Instrumentation companies are growing in presence at the A.I.C.D. This is due to the growing trend to truly measure and manage the compressed air system. Beko introduced a new oil sensing and measurement device, dew point and pressure measurement instruments were displayed by Testo, Vaisala and Cosa Instruments. Ultrasound leak detection instruments were available to try out at the booth of UE Systems.

Conclusion

To top things off, the Golf Outing was a success as was the big Casino Night. The A.I.C.D. will be holding next years meeting in Santa Fe, New Mexico and preparations are already underway. I'm looking forward to another educational (and fun) trip. BP

For more information, please contact Cheryl Kiker at aicd@aicd.org or visit www.aicd.org

The Annual AICD Golf Outing was a Success

Tuthill Vacuum and

Compressed Air Best Practices™ spoke with Howard DeCelis (Director of Blower Systems) and Angie Burlison (Marketing Coordinator) at Tuthill Vacuum & Blower Systems

Good morning. Please describe the structure of Tuthill Corporation.

Good morning. Tuthill is a privately held corporation, headquartered in Burr Ridge, Illinois. We have eight lines of business; Vacuum and Blower Systems, Controls Group, Coupling Group, Drive Systems, Plastics Group, Pump Group, Transfer Systems and Transport Technologies.

The company was founded in 1927 when James Tuthill, the great-grandfather of the current owner, began to market a newly designed internal gear pump.

What does it mean to be a "Conscious Company?"

Tuthill Corporation has been on a journey to become a Conscious Company since 2005. We strive to create an environment where individuals are both motivated and effective. This journey has started at the top with Jay Tuthill, Chairman and CEO and with Tom Carmazzi, our President and CEO. Mr. Tuthill even leads some of the training classes. Some of the key topics/areas we work on are awareness, responsibility, intention, choice and impact.

How is the Vacuum and Blower Systems group structured?

The Vacuum and Blower Systems Group has been headquartered here in Springfield, Missouri since 1969. We have been in the blower business since 1937. We have roughly 325 employees here in Springfield and a total of approximately 400 employees worldwide. We operate manufacturing facilities in Europe, Argentina, Australia and China.

Please describe your core markets for your vacuum pumps and blower systems.

We sell our vacuum pumps to many different industries. Heat treatment is a major application in metallurgical, cutting tools and metalworking applications. Other industries include chemical and pharmaceutical processing and solar cell manufacturing. Our primary blower markets are pneumatic conveying, wastewater treatment, chemical and bulk handling applications.

How are energy-cost awareness levels with the users of blower and vacuum systems?

Everyone is becoming more energy conscious. Customers are listening more and beginning to shift towards lower cost of ownership. Tuthill has responded by developing new product lines, which reduce the cost of ownership. The new Qube rotary lobe blower package is an example of Tuthill's commitment to new product development.

What has made the Qube blower more energy efficient?

The first improvement in energy efficient has come from a more efficient rotor profile. Using computerized fluid dynamics of the rotary lobe, our engineers were able to improve the rotor efficiencies by 15% over competitive designs! We have launched seven models from 20 to 150 horsepower, which can deliver flows from 15 cfm to 1950 cfm at pressures up to 18 psig or 17 inches of mercury vacuum.

A second improvement has come from package efficiencies. We use premium efficiency motors and now have an automatic belt tensioning system. We have also eliminated a fan motor from the package by letting the fan be driven by the blower shaft.

The blower shaft drives the cooling fan — eliminating an extra fan motor

Is sound attenuation becoming an issue?

Absolutely. Industrial customers are demanding enclosures and Tuthill is one of the first in the market to standardize on enclosures — as you can see with the new Qube product line. All models now come with

Blower Systems

standard enclosures, which provide sound attenuation levels from 75–85 dba. The market has changed and is looking for quieter machines, which can improve the work environment and be less disruptive in outdoor installations near residential areas.

Sound Attenuating Enclosures on the new Qube Series

What energy-saving tools can Tuthill provide customers?

Many customers want to get involved with sizing blowers. They want to know what their energy costs will be under different working scenarios with different machines. We have recently upgraded our sizing tool called BlowerXpert which makes this possible.

BlowerXpert can be downloaded by customers. A user can look at a performance curve to find the optimal blower for his application. An end user might determine that he needs 300 cfm at 12 psi pressure. He would look at a performance curve and select to go at 3,000 rpm — requiring a 32 hp motor.

The sizing tool can refine that selection. With that same application, the customer might determine that he can run at 2,800 rpm, which consumes less horsepower and would require a smaller motor size. BP

Thank you for your insights.

For more information, please contact Mr. Howard DeCelis, Tuthill, tel: 417-865-8715, email: hdecelis@tuthill.com, www.tuthill.com

Tuthill – Conscious Leadership

Awareness: The primary objective in this training is to turn up the awareness of what's going on with the thoughts and feelings inside of you, the people next to you and in the world around you.

Responsibility: With awareness comes a whole world of choice and possibility that can lead one down a path of creating exactly what he or she wants. Being responsible is a very powerful option should you choose to exercise it. Don't walk through life as a victim with your head hanging low, instead pick up your head and make a choice that will lead you down a better road. Don't belittle people around you, instead call them forth to be great and see what can be accomplished then. Don't steal credit from people or do things in their place because your way is better, instead honor their achievements and learn from how they did it.

Intention: Employees are asked to take a deep look at what they want personally and to speak up about it so that an overlap between their wants and the company wants can be identified. Once this occurs, employees become both more motivated to come to work everyday and more effective at what they're working on.

Choice: Understand what options are available to you. Sometimes you need to think outside of the box and sometimes you will need help. Remember to ask for it if you need it, then pick. If your choice doesn't have the impact you desire just pick another option and try again.

Impact: Watch what you've created unfold right before your very eyes. If it's not what you intended, take a closer look at the options you've exposed and the choices you've made. The possibilities are without bounds!

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BENEFITS

As part of the technology and specialty pavilions at NPE2009, Compressed Air World will be in "Technology Central" in the West Hall and co-located with the NPE Educational Program that will feature ANTEC@NPE2009 produced by SPE and the SPI Business of Plastics conference.

The Compressed Air World pavilion will be the hub of activity for the compressed-air segment of the plastics industry. An exhibit in the pavilion can be your main set-up at NPE2009 or a satellite of your full display, elsewhere, to highlight a specialty of your company.

FEATURES

West Hall, Booth #115025

Size: 4,000 square feet total with two options for exhibiting.

Option 1: 1,500 square foot display area for turnkey kiosks. A station within a kiosk includes graphic header, stool and lockable cabinet.

Option 2: Sixteen 10x10 traditional booths or combinations.

This space includes a 1,500-square-foot display area where individual turnkey kiosks will be located around an Information Center and a lounge area. The remaining 1,600 square feet is set aside for traditional booths.

Commercial Participation Package

SPI Members: turnkey kiosk, $2,250
exhibit space, $22.50/sf
Non-Members: turnkey kiosk, $3,600
exhibit space, $36.00/sf

- 1 literature slot in the NPE2009 Literature Distribution Center
- Lead/data collection service
- Session keyword matching
- Extensive pre-show and onsite marketing campaign.

ANTEC@NPE2009

ANTEC 2009

NPE2009 will include the Society of Plastics Engineers' ANTEC 2009, providing attendees with the largest technical educational program ever offered at an international plastics trade show: more than 650 presentations of peer-reviewed papers, plus seminars, workshops, and forums.

Join the Compressed Air World Pavilion at NPE2009 today.

Call Iain Thomas
at +1.312.673.4816,
e-mail iain@npe.org.

* *The full program is under development and subject to change.*

For more information, call +1.312.321.5171, e-mail exhibit@npe.org, or visit www.npe.org.

spi Produced by the plastics industry trade association

RESOURCES FOR ENERGY ENGINEERS

TRAINING CALENDAR

TITLE	SPONSOR	LOCATION	DATE	INFORMATION
Fundamentals of Compressed Air	Compressed Air Challenge®	Downey, CA	7/23/200	www.compressedairchallenge.org
Humidity Measurement Training Seminar	Vaisala	Baltimore, MD Dallas, TX	8/13/2008	www.vaisala.com/seminar
Compressed Air Management	Power Supply Industries	Fenton, MO	8/19/2008	www.psiind.com
Humidity Measurement Training Seminar	Vaisala	Boston, MA	9/8–11	www.vaisala.com/seminar
Best Practices in Compressed Air	World Energy Engineering Conf.	Washington D.C.	10/2/2008	www.energycongress.com
Humidity Measurement Training Seminar	Vaisala	Toronto, ON	10/8/2008	www.vaisala.com/seminar
Compressed Air Management	Power Supply Industries	Fenton, MO	11/4/2008	www.psiind.com
Humidity Measurement Training Seminar	Vaisala	Chicago, IL	11/5–6	www.vaisala.com/seminar

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

PRODUCT PICKS

New Variable Speed Compressor

Devair has launched the new "G" series of 20, 25 and 30 hp rotary screw compressors. The "G" series compressors are available in stand-alone base and tank mounted package configurations, complete with 120 gallon air receiver, dryer and air filter. The package is very quiet, extremely reliable and comes equipped with the new CSC200 microprocessor controller and an easy to use LCD display.

All "G" series compressors are available as the new energy-saving DVS (DEVAIR VARIABLE SPEED) models. The DVS module constantly matches the energy use with air demand, as your air consumption rate changes, DVS will smoothly adjust the motor speed to maximize energy efficiency.

The motor and variable speed module are matched to provide optimum performance and reliability at all times.

Devair Inc.
Toll Free: 800-552-7954 (USA),
800-668-8558 (Canada)
www.dvair.ca

Dew Point Meter

The COSA Model LPDT loop powered dew point meter features a robust LCD display with a 4-20 mAdc transmitter output and ideal for low DC supply power applications. Field span check, selectable display units and the stainless steel enclosure are standard features in this model.

HCOSA Instrument Corporation
Gene Hughes
201-767-6600 x330
GHughes@cosaic.com
www.cosa-instrument.com

RESOURCES FOR ENERGY ENGINEERS

PRODUCT PICKS

Air Compressor Line Expansion

Sullair announced a line expansion of the S-*energy*® Series compressors. A broad range of these lubricated rotary screw air compressors is now available in both constant speed and variable speed drive models, ranging from 15 (11 kW) to 100 (75 kW) horsepower with capacities of 44 to 500 acfm and pressures from 100 to 175 psig.

Today's energy costs represent 82% of the expense of compressor ownership. The combination of the S-*energy*® Series energy-saving features has proven most effective in reducing total life cycle costs, more than other compressors of similar design and horsepower range. Contributing to the energy savings is Sullair's time-tested air-end design with the low restriction inlet valve, low-pressure drop air-fluid separation system that prevents energy loss and a high efficiency fan.

Additional energy savings are achieved with optional Variable Speed Drive (VSD) compressors that provide the flexibility to vary both capacity and pressure to match system demand. On models with Variable Capacity Control (VCC), Sullair's variable displacement air-end matches system pressure to plant demand. Part load capacity and efficiency can produce additional energy savings up to 17 percent.

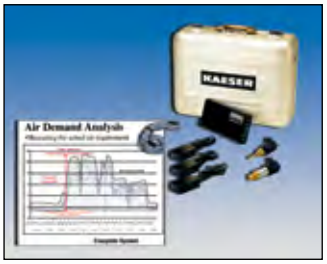
All models are available as a complete Performance Air System with optional integral Sullair SRS refrigerated dryers and filters for the most efficient removal of condensate and particulate. Because of their compact design, only a minimum amount of floor space is required.

Developed to meet virtually every requirement for cost-effective compressed air, the Sullair S-*energy*® Series compressors are also among the most reliable and maintenance-friendly compressors in the marketplace. Package designs meet the need for a small footprint and enclosures allow routine maintenance of consumable items to be performed from the same side of the compressor. The compressors' simplified, concise WS Microprocessor Control System provides critical operating information, including status, temperature, pressure and load/unload set points. A Windows-based PC can be used to remotely monitor, upgrade the software and set-up system changes.

Sullair
219-861-5159
www.sullair.com

Air Demand Analysis Program

Kaeser's Air Demand Analysis monitors and charts airflow, power consumption and system pressures during normal operating hours over a period of 10 days. Available for systems large and small, this exceptional tool creates a complete picture of air requirements including the relationship between peak and base load compressors and each compressor's duty cycle. Armed with this data, Kaeser's trained specialists can easily identify areas for improvement and if necessary, recommend equipment upgrades. Most equipment can be quickly and easily installed without interrupting daily plant operations while the results can provide lasting results for long-term planning… and save thousands of dollars in energy savings and productivity improvements too!



Kaeser
800-777-7873
www.kaeser.com

LAN/WLAN Ethernet Connectivity

Vaisala HUMICAP® Humidity and Temperature Transmitter Series HMT330, MMT330 and PTU300 and the Vaisala DRYCAP® Dew Point Transmitter Series DMT340 are now available with Ethernet connectivity through wireless or wired networks.

With the new Ethernet communication options you can connect the transmitter into a computer network providing a virtual terminal connection between the transmitter and a PC affording access to the instrument measurements via LAN and the worldwide Web.

Each transmitter is given an IP address, making it a uniquely addressed device in the network. The LAN and WLAN options make it easy to add a new humidity transmitter to an existing Ethernet network. Applications that do not allow holes through walls and ceilings, or the installation of new cables, benefit from the wireless solution.

Vaisala
888-VAISALA
instruments@vaisala.com
www.vaisala.com/HMT330

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 June 1, 2008.

CHARLOTTE, N.C., May 1 — EnPro Industries (NYSE: NPO) today reported record quarterly sales and segment income in the first quarter of 2008, as sales grew by 14% over the first quarter of 2007 to $283.1 million and segment income grew by 11% to $46.8 million.

Net income in the quarter was $13.2 million or $0.61 a share, compared to $12.3 million or $0.56 a share a year ago. Before asbestos-related expenses and other selected items, income was $23.0 million, or $1.07 a share, compared to $21.0 million, or $0.95 a share in 2007, a per share increase of 13%.

A table showing the effect of asbestos-related expenses and other selected items on net income, and earnings per share in both periods is included in this release. The items include expenses of $2.4 million, before tax ($1.5 million, after tax), for the company's proxy contest with Steel Partners, which was settled on April 11. Per share amounts are expressed on a diluted basis throughout the release.

WALL STREET WATCH

"We are pleased by the results of the first quarter," said Steve Macadam, president and chief executive officer. "They reflect the sound condition of most of our key markets and they underscore the effectiveness of our strategies and the strength of the performance culture at EnPro. It's a privilege to join a company with such a strong record of sales and income growth and to have the opportunity to lead it to continued success in the future."

The 14% increase in the company's sales over the first quarter of 2007 reflects the contributions of acquisitions and the strength of the company's international markets, as well as continued organic growth. Acquisitions, combined with increased activity in certain areas of the company's markets, added about 9 percentage points of the increase in sales, while foreign exchange contributed about 5 percentage points.

"The segment's operating profit increased by 16% to $21.8 million as all businesses in the segment reported improvements."

Segment profits grew by 11% as the Engine Products and Services segment reported a 75% increase and the Engineered Products segment reported a 16% increase. Profits in the Sealing Products segment were about the same as a year ago. Segment margins decreased to 16.5% from 17.1% as conditions softened in the heavy-duty truck market and other markets served by certain areas of the company's higher margin businesses.

Engineered Products

Sales in the Engineered Products segment increased by 25%, to $133.1 million, also a record for the first quarter. Acquisitions contributed about 12 percentage points of the increase while favorable foreign exchange rates contributed about 7 points. At GGB Bearing Technology, increased demand from European industrial markets and favorable foreign exchange rates led to higher sales. Sales at Compressor Products International (CPI) doubled from a year ago, primarily as a result of acquisitions completed in the second half of 2007. Quincy Compressor's sales were about the same as a year ago.

($ MILLIONS)		
Quarter Ended	3/31/08	3/31/07
Sales	$133.1	$106.3
Profit	$21.8	$18.8
Margin	16.4 %	17.7 %

The segment's operating profit increased by 16% to $21.8 million as all businesses in the segment reported improvements. However, the segment's margins declined to 16.4% from 17.7%, primarily because of lower margins at CPI. CPI's margins were affected by softer conditions in its Canadian markets and by integration costs and increased OEM shipments, which generally carry lower margins, at its operations in the United Kingdom. BP

JUNE 1, 2008 PRICE PERFORMANCE	SYMBOL	LAST PRICE	1 MONTH	6 MONTHS	12 MONTHS
Parker-Hannifin	PH	$72.26	-13.6%	-5.3%	9.3%
Ingersoll Rand	IR	$37.07	-14.0%	-19.5%	-31.7%
Gardner Denver	GDI	$55.00	3.6%	72.1%	33.5%
United Technologies	UTX	$60.68	-11.6%	-19.4%	-13.0%
Donaldson	DCI	$43.88	-12.3%	-3.8%	25.6%
EnPro Industries	NPO	$36.05	-7.1%	21.8%	-12.7%
SPX Corp	SPW	$129.47	-2.5%	28.1%	50.0%

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JOB MARKET

Job Openings in the Compressed Air Industry

TECHNICAL SALESMAN

GRS Fluid Handling is working with a client who is a top manufacturer of compressed air products and equipment to search for a top technical salesman. This position will oversee sales for a Western Regional territory and be responsible for the total sales performance of their blower line.

Background Required

- Successful track record of selling blowers; Preferably positive displacement blowers
- A four-year degree, preferably a technical degree
- Ability to work autonomously, based in a home office
- Ability to travel a west coast territory as required

Why you would want this job?

- Company offers security
- Ability to work for a growing division of a well-established global manufacturer
- Future advancement and growth opportunities throughout the organization
- Very visible position, where someone's hard work will not go unnoticed

This position offers a chance to move into a highly visible role with distinct responsibilities and challenges. It offers the chance to work autonomously and grow a business segment. Our client is well respected with a great product and talented support staff.

For more information, please contact Joe Bertolami, GRS, tel. 440-684-6150 *3007, e-mail jbertolami@grsrecruiting.com; www.grsrecruiting.com

ROTARY ENGINEERS

PARTS IDENTIFICATION SPECIALIST

MARKETING MANAGER

North Carolina manufacturer of complete compressed air systems has several openings. Excellent benefits, salary based on experience.

Please e-mail resume as a Word document to: pdavis@jpsource.com

REGIONAL SALES MANAGERS

AIR COMPRESSORS 5-300HP

Industrial Compressor manufacturer is in process of expanding nationwide sales coverage and is now recruiting for qualified candidates to fill two new positions within the following geographic areas:

Opportunities

- In Southwest Region
- In Upper Midwest Region

Requirements

- Experience within the compressed air industry
- Travel a 4–5 state sales territory
- Ability to build and support industrial distributor network
- Ability to assist distributors with compressor applications
- Ability to sales train distributors on complete product line

Benefits

- Opportunity to work with a fast-growing company
- Several new product lines being launched in 2008
- Benefit package, 401K
- Company car, expense account
- Future advancement and growth opportunities

These positions also offer an opportunity to work within the framework of a leading world-class global compressor company and utilize available resources. New production equipment and ERP systems have been recently implemented to meet our rapid growth rate.

For immediate and confidential consideration, please send your resume to: humanresources@curtistoledo.com

World Energy Engineering Congress returns to nation's capital in 2008!

WORLD ENERGY ENGINEERING CONGRESS
WEEC 2008

Presented by
The Association of Energy Engineers

Hosted by
SAIC From Science to Solutions

Featuring
Green Street EXPO @ WEEC
Sponsored By
CHANGE FOR THE BETTER WITH ENERGY STAR

The key opportunity of the year for end users and decision-makers from business, industry, and government sectors to learn about the newest technologies, hear industry's leading experts, and network

The Association of Energy Engineers (AEE) is very pleased to bring the **WORLD ENERGY ENGINEERING CONGRESS (WEEC)** to Washington, DC for 2008—and to an extraordinary new venue—the Gaylord National Convention Center on the Potomac. Now in its 31st year, the **WEEC** is well-recognized as the most important energy event of national scope for end users and energy professionals in all areas of the energy field. It is the one truly comprehensive forum where you can fully assess the "big picture" – and see exactly how the economic and market forces, new technologies, regulatory developments and industry trends all merge to shape your critical decisions on your organization's energy and economic future.

The **WEEC** conference and expo target the complete spectrum of technologies and services of greatest importance to our delegates in attendance, including, but not limited to:

energy management • combined heat & power / cogeneration / distributed generation • lighting efficiency thermal storage and load management • integrated building automation • industrial energy strategies boilers and combustion controls • green & sustainable initiatives • geoexchange technologies renewable and alternative energy energy management • HVAC systems and controls energy services and project financing • solar and fuel cell technologies applications specific to federal energy management programs

WEEC's highly acclaimed **GreenStreet expo showcase**, introduced in 2007 and co-presented by the U.S. EPA's ENERGY STAR®, will again be a prominent part of the WEEC for 2008. Here you can examine firsthand the latest green / sustainable / environmentally friendly energy technologies now available for both new design and retrofit projects.

Government Energy Leaders

Department of Defense

GAO Accountability * Integrity * Reliability

NTIS U.S. Department of Commerce National Technical Information Services

Red Star Energy Leaders

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CHRYSLER Jeep DODGE

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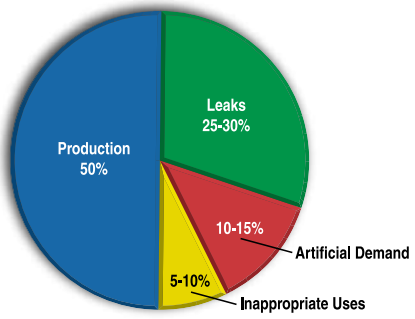
www.energycongress.com

At Kaeser, our tradition of saving energy goes back generations.

Energy costs have never been higher. That's why it's so important to get maximum efficiency out of your compressed air system. And with as much as 50%* of compressed air being wasted, you could save a bundle.

Trust the specialists at Kaeser to find energy savings by reducing inefficiency in your air system, while also cutting maintenance costs and delivering process improvements. We are the industry leader in conducting *true, comprehensive* air system audits, so you know you'll get the best possible advice and recommendations.

Visit **www.kaeser.com/ada** to see if you'll benefit from an Air Demand Analysis (ADA) - and how we've helped other plants significantly improve their bottom line.



*Only 50% of compressed air is actually put to productive use.**

KAESER COMPRESSORS

Built for a lifetime.™

www.kaeser.com/ada

Member of CAGI Compressed Air and Gas Institute www.cagi.org

Kaeser Compressors, Inc., Fredericksburg, VA USA ■ (866) 516-6888

* Source: *U.S. Department of Energy; Compresed Air Challenge®.*

Certified Management Systems ISO 9001:2000 Quality 14001:2004 Environment