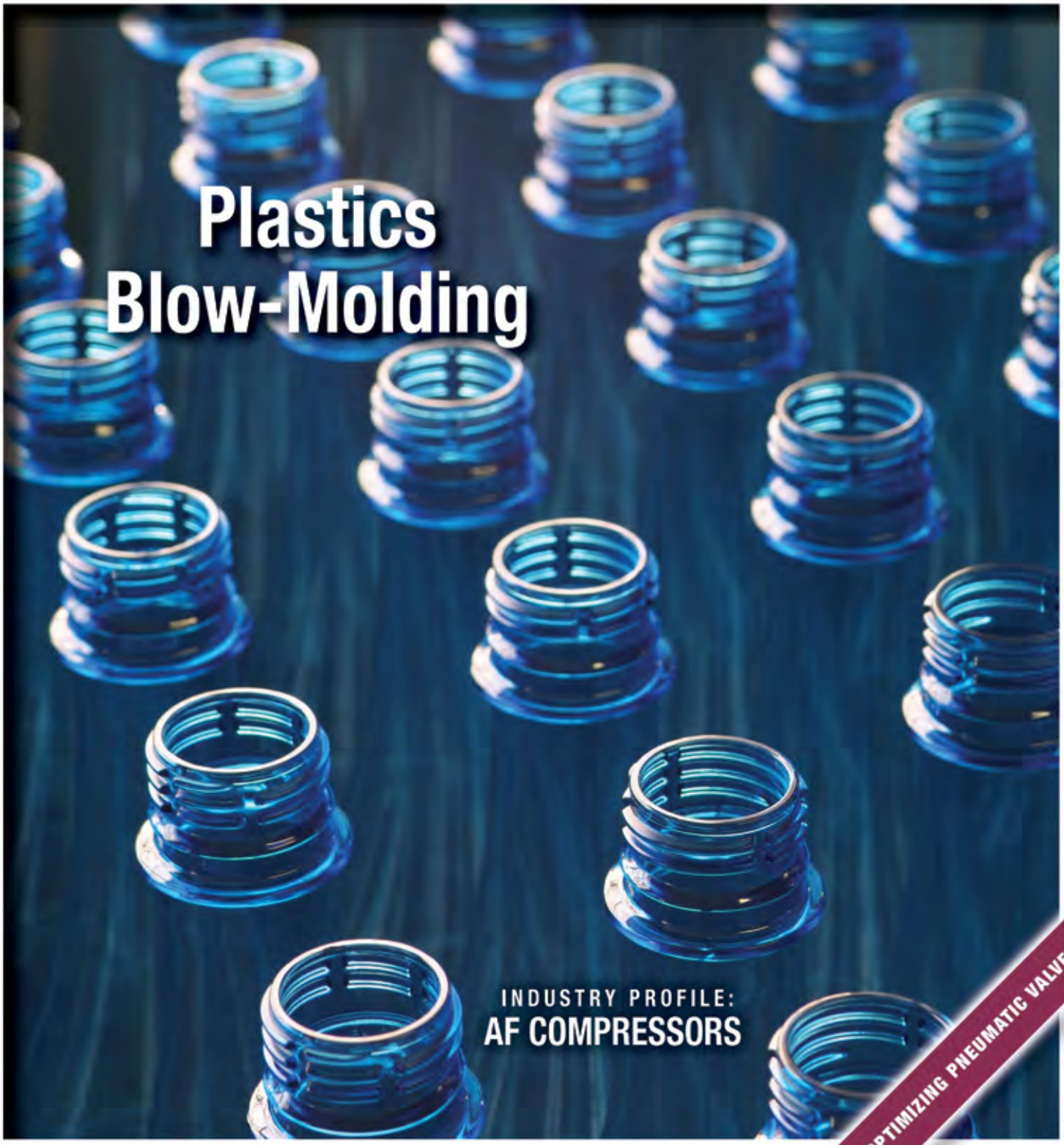
Audit ROI Guarantees Boosters for PET Vacuum

April 2008

COMPRESSED AIR BEST PRACTICES™



Plastics Blow-Molding

INDUSTRY PROFILE:
AF COMPRESSORS

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FROM THE EDITOR

A Bright Future for Compressed Air Energy Management

As I listen to the doom and gloom of the politicians and broadcasters on TV, I feel lucky to be involved with a long-term growth industry. Energy management, as a whole, is a growth industry and compressed air system energy management is participating.

The PET blow-molding market has a bright future. Compressed air is used at ca. 40 bar (572 psig) to blow the bottles to size from their original pre-form molds. The desire to use less plastic has led to lighter-weight plastics where we now see 30 bar compressed air being used. These same systems have lower pressure compressed air (11–25 psig) for blow-off and air knife processes.

Compressed air systems for PET plastic blow-molding operations are fertile grounds for energy managers. **Dean Smith**, a veteran auditor of the blow-molding industry, shares examples of where he finds energy saving opportunities with us in the "April Audit of the Month." Dean also, in a separate article, discusses how audit ROI's can be guaranteed so that CEO/CFO level executives will have more confidence investing in facility energy management projects.

We are excited to announce a strategic alliance between Compressed Air Best Practices™ Magazine and **NPE 2009** — the prestigious trade show and conference for the plastics industry (www.npe.org). NPE 2009 is organized by the Society of the Plastics Industry (SPI) and will be held in June of 2009. We will sponsor a Compressed Air Pavilion where we can draw attention to the opportunities to improve compressed air systems in the plastics industry.

Manufacturers who design and build energy-efficient products also have a bright future. **AF Compressors** is a manufacturer of three-stage reciprocating air compressors designed for the PET industry. They tell us a story, in this edition, on how the company started to grow when they decided to focus exclusively on providing 40 bar, oil-free air. Their future is bright as they are now building a new factory in China to keep up with the booming blow-molding market there.

There is a time and place for every technology and our regular contributor **Hank Van Ormer** provides advice on when to use boosters in PET systems. A huge (and relatively untapped) opportunity for energy savings exists with blower, vacuum and pneumatic systems. **Dan Bott** (also known as Dr. Vacuum) talks to us about managing differential pressure in vacuum and **Chris Landis** discusses pneumatic valves in this months' edition.

Thank you for your support and keep up the good work in energy management.

ROD SMITH

UTILITY-AIR NEWS

NPE2009 Compressed Air Pavilion

The Society of the Plastics Industry (SPI) and Compressed Air Best Practices™ Magazine have formed a strategic alliance to create a Compressed Air Pavilion at NPE2009.

Gene Sanders, vice president, Trade Shows, at SPI commented, "We're excited about every aspect of the value chain in the plastics industry. Compressed air is a important part of the blow-molding process."

Anchored by Compressed Air Best Practices™ Magazine, the Compressed Air Pavilion will provide plastic industry professionals with information on how to optimize their compressed air systems. The focus will be on how to reduce energy costs and on how to improve production processes like blow-molding by reducing pressure fluctuations.

The Compressed Air Pavilion has a concentration of kiosk and booth spaces where compressed air energy consultants and equipment suppliers can meet with plastic industry professionals.

NPE2009 is a triennial event sponsored by SPI and held at Chicago's McCormick Place exhibition center. The world-scale NPE2009 exposition will take place June 22–26, 2009. The exposition expects to receive 75,000 visitors to visit over one million sq. ft. of net exhibit space.

For more information on exhibiting at the Compressed Air Pavilion, contact Alan Carter, tel: (202) 974-5284, email: acarter@plasticsindustry.org, www.npe.org/exhibit

World Energy Engineering Conference Announces Session on Best Practices in Compressed Air

The Association of Energy Engineers (AEE) and Compressed Air Best Practices™ Magazine announce a Conference Session on Best Practices in Compressed Air at the World Energy Engineering Conference (WEEC) on October 2, 2008.

Compressed Air Best Practices™ Magazine will chair the session featuring the following presentations from compressed air industry experts:

1. "ROI Guarantees on Compressed Air Audits" by Dean Smith, iZ Systems
2. "Emerging Technologies for Reducing Compressed Air Demand" by Hank Van Ormer, Air Power USA
3. "Energy Conservation in Pneumatic Systems" by Mike Nagy, SMC
4. "Best Practice Blow-Off Systems" by Ed Ball, Process Air Solutions

The WEEC conference and expo will be held October 1–3, 2008 at the Gaylord National Convention Center on the Potomac in Washington D.C. 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.

The AEE is a nonprofit professional society of 8,500 members in 77 countries. AEE's roster of corporate members is a veritable "who's who" from the commercial, industrial, institutional, governmental, energy services and utility sectors.

For more information on the WEEC visit www.energycongress.com

DOE's "Save Energy Now" Assessments

The U.S. Department of Energy Save Energy Now initiative helps U.S. businesses, factories and manufacturing facilities save energy and continue to thrive despite variable energy costs. In the last two years, many companies working in partnership with DOE have already benefited from taking part in assessments. On average, each large plant assessment yields potential savings of $2.5 million. Implementing measures could help these plants save 10% or more per year on energy bills, not to mention productivity improvements and avoided carbon emissions.

Save Energy Now assessments primarily focus on energy-intensive systems: process heating, steam, compressed air, fans and pumps. The Save Energy Now application process is now open to have a energy assessment done at individual facilities. Through Save Energy Now, DOE offers these energy assessment options:

1. For large plants: The nation's largest, most energy-intensive plants can apply to receive a three-day system assessment. These on-site assessments are led by DOE's Energy Experts who use DOE's software tools and technical information to target a specific system area. Assessments also provide valuable hands-on learning that can help your staff gain knowledge to multiply the benefits of the assessment.
2. For small and medium-sized plants: DOE's university-based Industrial Assessment Centers conduct one-day assessments at smaller plants. Teams of highly trained IAC faculty and engineering students apply the same DOE software tools and technical resources to identify key savings opportunities throughout your plant.

For more information, visit www.eere.energy.gov/industry/saveenergynow/

Southern California Edison IEEP Program

Southern California Edison (SCE) has information online about their Industrial Energy Efficiency Program (IEEP). The IEEP combines industrial energy expertise with incentives to help SCE industrial customers save energy, money and the environment. Companies can receive substantial cash incentives for process modifications and equipment retrofits which result in electrical energy savings. The amount of the incentive is tied directly to the amount of energy saved and can be quite significant for many customers.

SCE has assembled a team of industry and technology experts (IEEP contractors) to assist you in meeting your electrical efficiency needs. These energy professionals will:

1. Evaluate and identify energy efficiency opportunities
2. Prepare customized Energy Analysis Reports outlining project energy savings to obtain maximum program value
3. Facilitate the movement of the project through the IEEP process including coordinating the monetary incentives for capital improvements
4. Assist with project installation
5. Prepare all necessary program paperwork and arrange for financial incentive after project completion

Incentive payments are determined by the amount of annual kilowatt-hour savings through process improvements or equipment retrofits. Incentive rates for compressed air system energy reduction projects would fall under "Motors and Controls" and be eligible for $0.08/ kWh incentives.

SCE is the nation's leader in energy-efficiency savings. During the past five years, SCE's energy-efficiency programs have saved more than 4 billion kWh — enough energy to power 500,000 homes for an entire year and reduce greenhouse gas emissions by more than 2 million tons — the equivalent of removing 250,000 cars from the road.

For more information on the IEEP visit www.sce.com/RebatesandSavings

Compressed Air Audit of the Month

Minimizing Blow-Molding Pressure Fluctuations

By Dean Smith

April Audit of the Month

Where: Western U.S.

Industry: PET Plastic Blow-Molding

Issue: Pressure Fluctuations Affecting Blow-Molding Pressures

Audit Type: Supply and Demand Side

Compressed Air Energy Costs:
Existing: $1,399,000*
Proposed: $1,248,000
Savings: $151,000

Audit Financial Summary:
Savings: $151,000
Capital Cost: $266,000
ROI: < 22 month simple payback

Audit Summary:

1. Stabilize low-pressure system pressure by adjusting control set-points on the VSD low pressure compressor
2. Reduce blow-air demand by stabilizing and reducing internal pressure at the blow-molding machines
3. Prevent loss of molding pressures and minimize unloaded compressor energy costs by automating the air compressors and using air storage

*Per Year Energy Costs Calculated at $0.0722/kWh.

Creating Stable Operating Pressures

Blow-pressure fluctuates in virtually all PET blow-molding facilities from 3 bar to as much as 6 bar. This forces the operating pressures to maximum levels in order to prevent low-pressure events from impacting the production processes. These fluctuations are caused by:

1. Poor air system controls
2. Inadequate storage
3. Installed pressure differential at the blow-molding machines

Previous technical evaluations confirm that this is the case at many other facilities (within this industry). Controlling header pressure and blow-pressures more accurately and at more appropriate levels can reduce compressed air energy costs by more than 20%.

A reduction in molding pressure results in a proportional reduction in high-pressure air consumed (assuming that most of the regulators are wide open) and with an automated supply system with appropriate storage, the energy will also be reduced proportionally.

If the compressor set-points are adjusted based on the reduced header pressures, then there will be an additional reduction in energy. With three-stage high-pressure reciprocating compressors, reducing discharge pressure (within the normal operating pressure range) reduces the energy required at the compressors by a ratio of 5 to 1, meaning a 5% reduction in discharge pressure provides a 1% reduction in energy on the compressor.

Optimizing the Air Supply System

The high-pressure compressors are started and stopped manually at this plant to prevent unnecessary starts on the motors. The lack of storage in the system results in rapid changes in pressure whenever a Sidel blow-molder starts or stops. It becomes necessary to keep a compressor running in the unloaded state so that it is prepared for the next Sidel to start. In addition, there are control problems with several of the compressors causing them to respond erratically to changes in system demand and pressure. The first step to managing these compressors without a significant investment is to install a signal header in each compressor area:

a. The signal header should be ¾" to 1" stainless pipe which connects to the header downstream of all dryers and filters so that it reflects header pressure. Each compressor is then connected to the signal header and its' controls can be adjusted to coincide with the settings of the other compressors

b. Choosing one compressor to auto-start in case of a compressor failure or a unexpected increase in air demand can prevent the low pressure level alarms which occasionally occur

Additional storage at the far end of the header will also help stabilize the system pressure. This is particularly important if any blow-molders are using balayage or heat-set processes. In this system, the addition of a 1,000-gallon receiver will provide more stable pressures during the transition periods of starting and stopping molding machines. The goal is to contain the pressures within 1% of set-point at all times so that starting a Sidel does not impact the other molding machines in the system.

Minimizing Blow-Molding Pressure Fluctuations

High-speed pressure recordings on the blow-molding machines indicate that the pressure drop and pressure fluctuations caused by the blow-air regulators range from 20–80 psig. As a process variable, compressed air is experiencing much more instability than any other part of the blow-molding process. It stands to reason that controlling this variable offers the potential to allow further increases in productivity or improved quality.

The first and simplest solution to minimize the losses through the regulator is to pipe a bypass around the regulator and/or the final filter (if redundant) based on the individual machine configuration. In all cases, the dump valve must remain between the rotary union on the molding machine and the air supply. This allows the dump valve to cut off the flow of air and relieve

Controlling header pressure and blow-pressures more accurately and at more appropriate levels can reduce compressed air energy costs by more than 20%.

COMPRESSED AIR AUDIT OF THE MONTH

Minimizing Blow-Molding Pressure Fluctuations

Table 1: Pressure at the blow-pin on a Sidel blow-molder with blow-air regulator wide open.

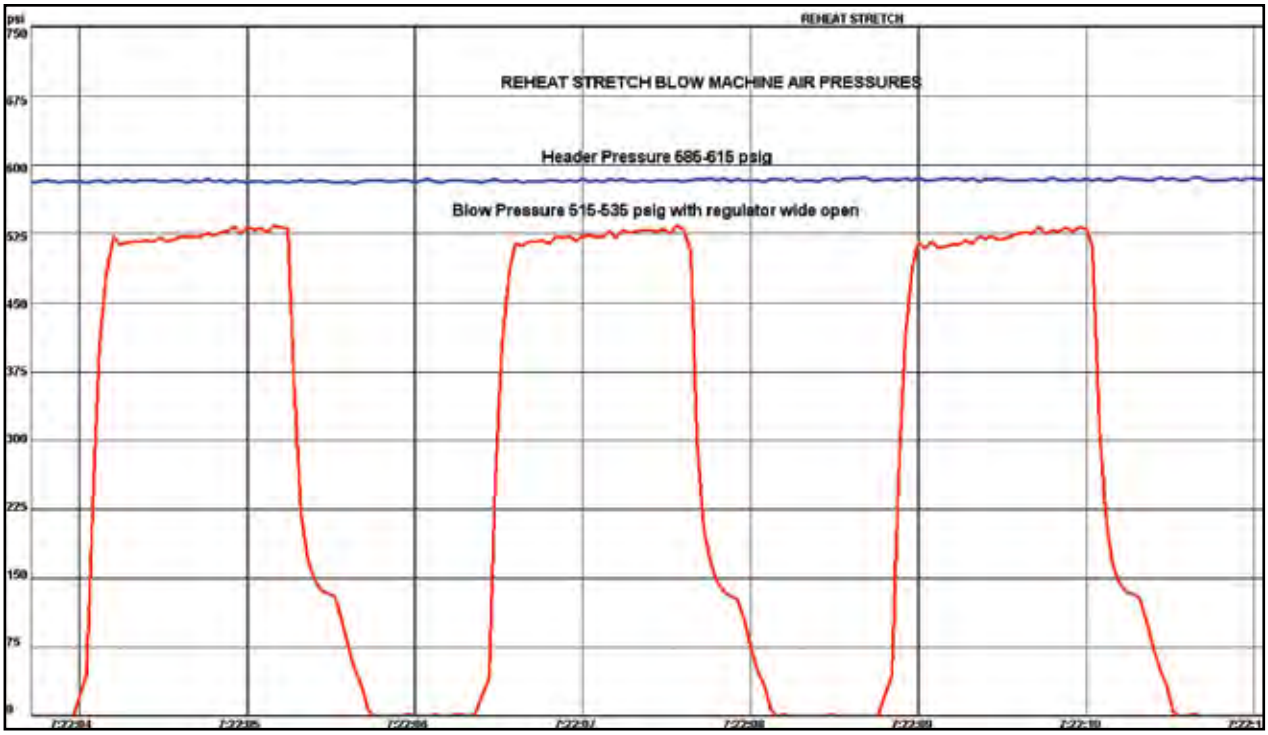


Table 2

Compressed Air Supply Power and Volume												
Existing Performance *Normal* Production Loads												
		Normal Demand				scfm/	Peak Demand *Summer*				scfm/
HP System		bhp	kW	scfm	% load	bhp	bhp	kW	scfm	% load	bhp
#1	3 stage recip	208	168.3	429	60%	2.07	273	221.6	690	100%	2.53
#2	3 stage recip	145	117.6	111	15%	0.77	220	178.4	465	65%	2.11
#3	3 stage recip	125	101.4	15	2%	0.12	165	133.8	325	45%	1.97
#4	3 stage recip	364	294.8	888	100%	2.44	375	304.0	856	100%	2.28
#5	3 stage recip	619	501.6	1661	100%	2.68	637	516.5	1600	100%	2.51
#6	4 stage recip	589	477.9	1758	92%	2.98	643	521.1	1840	100%	2.86
	Refrig Dryers	33	26.5	-			33	26.5	-		
	HP Subtotal	2,082	1,688	4,862	73%	2.34	2,346	1,902	5,777	90%	2.46
LP System											
#7	rotary screw	256	207.8	840	85%	3.28	256	207.8	840	85%	3.28
#8	rotary screw	*backup*					*backup*				
#9	VSD screw	195	158.3	783	100%	4.01	195	158.3	783	100%	4.01
	Refrig Dryers	9	8.4	-			9	8.4	-		
	LP Subtotal	460	374	1,623		3.53	460	374	1,623		3.53
Combined Totals		2,542	2,062	6,486		3.46	2,806	2,276	7,400		2.64

downstream pressure in an emergency. The bypass can then be closed for any molder, which will accept lower blowing pressures than the header provides, or the bypass can be opened for any molder, which requires header pressure directly to the mold. It is important to note that the pressure inside the molding machine will actually be more stable with the bypass open than it will be with the bypass closed. This is because the regulator is not capable of reacting as quickly as required to support the blow process in real time. The regulator, in addition to creating pressure loss, continually lags behind the process causing the pressure to fluctuate dramatically.

Managing Multiple Air Compressors with Storage and Pressure Control

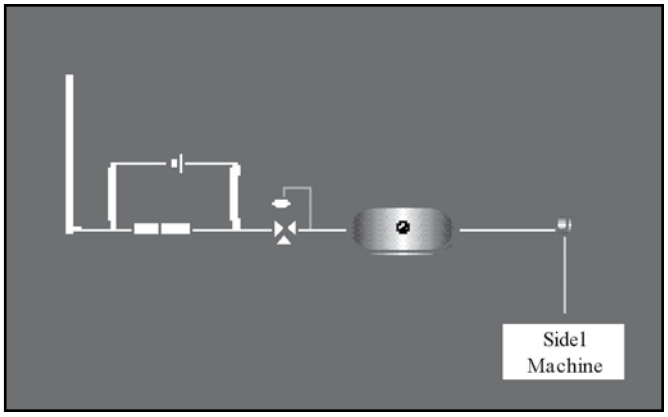
Please refer to the table below and note that an average production day operates all six operable high-pressure compressors during peak production periods and five or six during the remainder of production operations. However, several of the compressors are operating in an unloaded condition for extended periods. Therefore, the most significant energy reduction opportunity exists in managing the compressors to minimize unloaded time by more accurately responding to the changes in air demand occurring as the molders start and stop.

This will require additional storage and pressure control. A pressure flow controller will respond to changes in demand by modulating the flow control valve to match the down stream requirements. This is different from a regulator in that it does not introduce a fixed pressure drop in the system to limit maximum pressure but rather controls flow across the valve to match the demand and maintain a fixed pressure on the demand side. This creates useful storage in the new tank, which can then be used to satisfy short peaks in demand and provide time to start and stop compressors as necessary.

The new receiver should be a 5,000-gallon tank (min. 750 MAWP) and should be located after the dryers and filters but just upstream of the flow controller in the main compressor room. The tank can be located outside the room on the existing pad that holds the plastic silos. This size receiver provides 46 cf/psi of useful storage with a pressure range of 50 psig. It can provide 2300 scf of air before it is necessary to start a compressor. In terms of protecting productivity, this storage will provide over 80 seconds to auto-start a backup compressor when one of the larger three-stage recip compressors fails.

Pressure Gradient Automation

The opportunity for energy savings in this system is significant and can provide a very attractive return on investment while providing a system that is clean, dry and more stable in pressure. The energy savings revolve around stabilizing the pressure to eliminate artificial demand and production variations at the molding machines and providing an automation system to minimize the compressor power required to support the rapidly changing demand for air.



COMPRESSED AIR AUDIT OF THE MONTH

Minimizing Blow-Molding Pressure Fluctuations

Achieving Stable Pressure at the Blow-Molding Machine

After installing a bypass and storage tank, it is reasonable to expect to achieve pressure stability within +/- 1–2% which will allow pressure reductions of 1.5–2.0 bar in header pressure.

Rate of Change automation can differentiate between a compressor failure that should be reacted to immediately and a large demand side event that should be allowed to use the available storage in order to avoid a compressor start. Stable header pressure is the first step and can only be created in a PET blow-molding system through the use of flow controllers and additional storage as previously installed in this plant. In this manner, the recommended storage can be fully utilized while minimizing the risk of a production interruption due to compressed air problems.

Programming critical levels of storage will allow the automation to decide when it must react to preserve the system in virtually all conditions. The automation system must be capable of accepting designation of base load and trim compressors so that the reciprocating compressors in the system can be used in the most efficient manner. The automation platform should start, stop, load and unload all the compressors as necessary to provide the appropriate response to demand or supply changes. It is important to realize that in compressed air systems, one preventable start on a high-pressure reciprocating compressor will cost $2,000–$5,000 in electrical demand charges for that month; only automation can be attentive enough to prevent these costs.

Additionally, the appropriate automation system should use communication protocol from the main automation panel to the compressor interface panels to minimize the risk of a signal error and to minimize the installation costs. This system must be capable of interfacing with the compressors and must always fall back to active local compressor controls in such a manner that the compressor maintains its current operating status.

It is critical that the system not defeat or replace any safety circuits on the compressors, which are being controlled. The main panel should be located centrally in the maintenance area so that the system can be frequently monitored. The recommended automation system also provides a SCADA system for managing and monitoring efficiency.

Storage at the Blow-Molding Machine

The next, most significant step in stabilizing the blow-pressure is to install compressed air storage at the blow-molding machine as close to the rotary union as possible. For larger volumes of air this is more important, however, this step should only be taken after the previously recommended steps to stabilize system pressure. The diagram depicts the proper arrangement of the bypass and storage if required. With a bypass and storage installed, it is reasonable to expect to achieve pressure stability within 1–2% of set-point which will allow pressure reductions of 1.5–2.0 bar in header pressure without affecting final blow-pressure levels. The energy savings will approach 5% in addition to the 10% which can be achieved by reducing header pressures based on finer control of the automation and control valves in the system.

Table 3: Piping Pressure Drop

Piping Pressure Drop Calculations						<35fps
Nominal Pipe Size	Flow SCFM	Constant	Inlet PSIA	Length Feet	Drop psid	Velocity ft/sec
2	1,500	1050	515	30	1.1	32
3	3,000	245	515	30	0.3	29
4	4,000	277	515	300	2.8	22
6	12,000	282	515	300	2.9	29

Piping Pressure Drop

Piping pressure drop created by excess velocity can also be a contributing factor in the loss of pressure to the blow-molding machine. Normally the header sizes are appropriate at 6" and 8", which have sufficient capacity at these pressures to support the plant requirements. However, the drop sizes have become a problem as heat-set processes have become more common. The typical 2" drop is at its design limit with 1500 scfm at 500 psig but many of the same blow-molding machines now require in excess of 2000 scfm. This excess velocity does not create much pressure loss due to friction because the length of pipe is relatively short, however, the resistance to flow does allow the pressure to fluctuate more dramatically because of the restriction. We recommend that for new installations, 3" pipe drop should become the standard to avoid additional operating costs due to pipe restrictions. Headers should be 6" or greater to avoid the same problems on a systemic basis.

Maintaining System Efficiency

In our experience, preserving the operating costs savings created by upgrading the compressed air system in this type facility is the most difficult challenge. It requires diligent attention to the performance of the compressors and the process to prevent a gradual decline in efficiency and a return of the previous methods of operation. The long-term integrity of this system will be best protected by accurate and appropriate information regarding the systems performance and efficiency over time.

It is very difficult if not impossible to develop the long-term trending that is required to predict problems in a system this complex without a SCADA system (system control and data acquisition). A system designed by compressed air professionals will provide the proper information at a glance and trend performance against the Best Practice for the system to allow management to maintain the gains in efficiency (see attachments). For example:

a. A trend of efficiency in scfm delivered to compressor kW which is relative to the Best Practice standard developed for this specific system is an extremely valuable management tool for maintaining performance over the long term

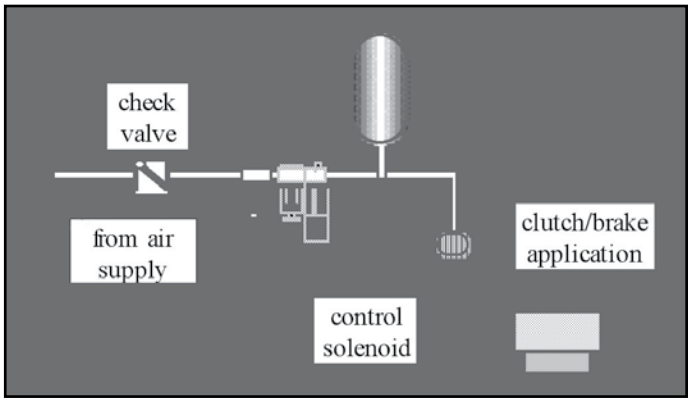
b. Data on the operating condition of all supply side equipment can be trended to predict developing problems and it can be used to track preventative and predictive maintenance

c. Compressor kW and valve temperatures provide indication of deteriorating performance prior to failures which will also allow the maintenance of the compressors to be scheduled based on deteriorating performance which will prevent a dependency on portable/rental compressors

d. Inexpensive flow meters at each molding machine provide the data to indicate air leaks and/or improper setup on mold changes. Confirming pressure and flow should be a critical setup parameter

COMPRESSED AIR AUDIT OF THE MONTH

Minimizing Blow-Molding Pressure Fluctuations



Controlling Plant Air Pressure

A 200 hp VSD and a 250 hp fixed speed rotary screw compressors supply the plant low-pressure air system. The plant air system pressure was operating at 135–145 psig during the audit and was controlled by the fixed speed compressors modulation. By adjusting the variable speed set-point to a lower level, we will be able to allow it to control the header pressure much more accurately and therefore at a lower pressure. With the header controlled at 130 psig, the power in the system will be reduced by >35 hp or a savings of >$15K per year.

The second fixed speed compressor should be set to auto-start at 120 psig so that it can provide automatic backup in case of a failure of one of the operating compressors. The two 250 hp compressors can be manually rotated into service on a weekly basis to maintain operating condition.

Some Sidel machines experience sensitivity to air pressure at the brake/clutch system. A small dedicated receiver with a check valve will protect the brakes on any molding machine from pressure fluctuations if required. Install the tank with a check valve per the diagram.

Proposed Performance Normal Production Loads												
		Average Demand				scfm/	Peak Demand *Summer*				scfm/
HP System		bhp	kW	scfm	% load	bhp	bhp	kW	scfm	% load	bhp
#1	3 stage recip	181	146.6	310	43%	1.71	273	221.6	690	100%	2.53
#2	3 stage recip	282	228.4	738	100%	2.62	282	228.4	711	100%	2.53
#3	3 stage recip	*backup*					268	217.7	646	90%	2.41
#4	3 stage recip	*backup*					*backup*				
#5	3 stage recip	637	516.5	1661	100%	2.61	637	516.5	1600	100%	2.51
#6	4 stage recip	643	521.1	1910	100%	2.97	643	521.1	1840	100%	2.86
	Refrig Dryers	27	23.4	-			27	23.4	-		
	HP Subtotal	**1,769**	**1,436**	**4,619**	69%	2.61	**2,130**	**1,729**	**5,488**	86%	2.58
LP System											
#7	rotary screw	256	207.8	986	100%	3.85	256	207.8	950	100%	3.71
#8	rotary screw	*backup*					*backup*				
#9	VSD screw	158	124.3	593	76%	3.75	162	127.2	629	83%	3.88
	Refrig Dryers	9	8.4	-			9	8.4	-		
	LP Subtotal	**424**	**340**	**1,579**	58%	3.73	**427**	**343**	**1,579**	60%	3.70
Combined Totals		**2,192**	**1,776**	**6,197**		2.83	**2,557**	**2,072**	**7,067**		2.76

Conclusion

Pressure fluctuates in virtually all PET blow-molding facilities from 3 bar to as much as 6 bar. This forces the operating pressures to maximum levels in order to prevent low-pressure events from impacting the production processes. These fluctuations are caused by:

1. Poor air system controls
2. Inadequate storage
3. Installed pressure differential at the blow-molding machines

The technical evaluations confirmed that this is the case at this facility. Implementing the recommended actions at this facility will result in energy savings of $151,000 per year with a 21.8 month simple payback.

For more information please contact Dean Smith, iZ Systems LLC, tel: (404) 307-6836, email: dsmith@izsystems.com

FOCUSED ON 40 BAR, OIL-FREE AIR FOR THE PET INDUSTRY

Compressed Air Best Practices™ spoke with Joe Mashburn (Area Sales Manager) and Matt deLesdernier (Vice President of Operations) of AF Compressors USA.

Good afternoon! Can you describe the Ateliers Francois Company (AF Compressors) please?

Good afternoon. Ateliers Francois Compressors (AF) is a global compressor manufacturer focusing exclusively on the 40 bar, oil-free PET market. Our people understand the PET stretch blow-molding process and we have designed, produced and serviced air compressors to meet the needs of this industry. Our VP of Operations, here in the U.S. for example (Mr. deLesdernier), worked for CONSTAR in operations — before joining AF in 1994. He knows the small and big things that can be done to help our customers — because he was our first customer in the U.S.!

AF is headquartered in Liege, Belgium. This is where all of our air compressors are designed and manufactured. We have a second facility in Liege dedicated to aftermarket stock and delivery. All major parts for all models are in stock like cylinders, piston rods, cross heads and connecting rods. AF made this major investment to ensure that our customers experience no downtime. To serve the tremendous growth of PET blow-molding operations in Asia, AF has invested in a new manufacturing facility in China. This operation will officially begin production over the next few months.

What is the history of AF Compressors?

AF was formed in 1870 in Liege. The company manufactured reciprocating air compressors and pneumatic hammers for tunneling in the coal-mining industry. The block designs were based upon steam engine technology — which is why they are so durable! From 1890 to 1950, AF broadened its market to also supply reciprocating air compressors to the steel industry. Our facility was reduced to rubble in World War II, but the owners rebuilt and rose from the rubble on the same site we are at today. We know of several 100-year old AF air compressors in Europe which are still in operation!

From 1950 to 1980, AF began manufacturing oil-free reciprocating air compressors and this broadened the market to include chemical, glass and brewery industries. Then, with the emergence of a global PET industry in the 1980's, AF committed 100% of its resources to manufacturing and servicing 40 bar, oil-free air compressors for this industry. This focus has allowed AF to grow alongside the PET industry.

FOCUSED ON 40 BAR, OIL-FREE AIR FOR THE PET INDUSTRY

New lighter-weight PET plastics are allowing the use of 30 bar air pressure vs 40 bar air pressure

Please describe the growth of AF.

AF is a global leader in supplying air compressors to PET stretch blow-molding operations. This industry has grown tremendously in Western Europe and in North America over the past 15 years. AF has grown with it. We now support over 2,300 AF air compressors installed in over 135 countries. We have developed an international network of daughter companies and affiliates. We operate our own daughter companies in 10 countries including Germany, China, Dubai, India, Mexico, North Africa, Russia, Turkey, Thailand, Poland and the USA. We complement the daughter companies with a larger network of AF affiliates. All of these operations provide sales, aftermarket and service support to our blow-molding customers.

How does AF service the Americas?

AF USA was founded in 1995. Our full-service facility is located just outside Atlanta, Georgia. We have managerial responsibility for the Americas. Our facility has a spare parts inventory and a shop capable of refurbishing air compressors. Our service team is based here, but we do most of our work on-site with the customers in Canada, the U.S. and the Caribbean. We also have service agents based in California and Montreal to be close to our customers. Our daughter company in Toluca, Mexico services customers in Mexico and in all of Latin America.

Our testing facility in Liege is of great help to our diverse global markets. From Canada to Chile, blow-molding operations operate with many different voltages. We are able to test our air compressors before they ship, at 50 and 60 Hz and at 380 or 460V. We have even had some customers using 4,600 volts! We can accommodate different motor starters from soft-start, Wye-delta, to ramp-starts. Wye-delta is standard on our machines, but some customers choose the soft-start to generate energy savings.

AF has 2,300 compressors installed in over 135 countries

How does the blow-molding industry look to you going forward?

The number of blow-molding operations is growing rapidly in emerging markets like China, India and Russia. This is why we are opening our manufacturing operation in China and continue to open new daughter companies around the world. The growth rates in these regions are very exciting.

Growth in the Americas will continue to be solid and stable for blow-molding. This is a very recession-proof industry as people still need their soda, ketchup, mustard and bottled water. If the beer market fully embraced PET, then it would really grow, but it doesn't look like that is going to happen due to some recycling concerns. The trend here is towards reducing the carbon footprint involved with the blow-molding process.

How are blow-molders reducing their carbon footprint?

Blow-molders are reducing their carbon footprint by using lighter plastics and by consuming less energy. Lighter PET plastics are being used for water bottles, for example. We just attended a conference where they showed positive test results on half-liter water bottles, using less than 9 grams of PET plastic material. This amounts to over one third less material. Less plastic used means a reduced carbon footprint.

The lighter-weight bottles are also allowing for 28–30 bar (400–429 psig) air pressure. This can save considerable energy versus using 40 bar air (575 psig) in the blow-molding machine. The blow-molding machine manufacturers are designing machines that use less air at lower pressures and the blow-molders themselves are trying to optimize their compressed air systems.

Why has the three-stage, oil-free reciprocating compressor been the workhorse for PET applications?

It starts with reliability and ends with efficiency. Blow-molders have high-volume, round-the-clock operations, which can tolerate zero downtime. The three-stage design (in an L or W configuration) is an incredibly robust design for an air compressor.

The true engineering behind AF designs lies in delivering high volumes of air while running the compressor at slow speeds. This delivers compressed air energy to the process while reducing wear on critical components and reducing downtime. To give you an example, our 777 scfm compressor turns at 500 rpm. Other reciprocating compressor designs will turn at 735 rpm. This means less wear on connecting rods, main shaft bearings, connecting rod bearings and other components. This also means the air compressor is generating less heat — which the factory's HVAC system must compensate for.

AF compressor designs also feature the fewest valves in industry. To use the example of the 777 cfm unit, our design has only 12 valves. Other reciprocating compressors can have 24 valves. We accomplish this in our over-all design including having a dual-acting first-stage compression chamber which compresses air on both the up and down strokes. Fewer valves equates to greater reliability.

Blow-Molding Machine Manufacturers

- Sidel
- Krones
- SIPA
- Nissei
- SIG
- MAG
- SIAPI

FOCUSED ON 40 BAR, OIL-FREE AIR FOR THE PET INDUSTRY

The AF three-stage oil-free reciprocating compressor design

Can you talk about energy efficiency in the design?

Sure. When looking at energy efficiency we need to look at energy consumption at full loads and at partial or no load. Some blow-molders run consistently at full load while others (like converters) have quite a bit of downtime due to changing bottle sizes for different customers. If you compare our 1872 cfm, three-stage reciprocating compressor to a centrifugal compressor at full load, the centrifugal may use 90–100 kW more in energy.

At partial loads, the centrifugal compressor can turn down to only 80% of load and then has to blow the rest to atmosphere. The three-stage reciprocating compressor is a load/unload machine, which consumes only 12% of power when unloaded. The centrifugal stays at full power when unloaded. Blow-molders often have idling air compressors due to:

- Designing in excess capacity for peaks in production
- Filling lines getting jammed
- Labeling and air conveyor machines going down
- Changing bottle sizes
- Routine maintenance on air compressors

Those promoting centrifugal compressors will say that three-stage reciprocating compressors have higher maintenance costs. Our customers have found that the energy savings they realize with our designs more than offset these costs.

Unloaded three-stage reciprocating compressors consume only 12% of rated power

What air quality do blow-molders need?

The specifications call for ISO 8573.1 Quality Classes 1.4.1. This means particulate filtration of 1 micron, a pressure dew-point of 38 °F and oil removal to 0.01 ppm. We offer standard filter and refrigerated air dryer packages, which include all the 40-bar interconnecting piping along with the system. This simplifies the installation time and quality of the system.

We have one customer who also wants oil vapor removal filters in all their systems to protect against oil vapors in case hydrocarbons are present in the ambient air. Drink and food bottlers cannot afford to have any odors of oil present in their packaging. This is why oil-free air compressors are the standard in the industry and why we don't think using boosters (some being lubricated) along with lubricated screw compressors is a good idea. These systems depend upon impeccable performance and maintenance of the oil coalescing filters in the system to provide oil-free air.

Air Quality for Blow-Molding

Class 1:
0.01 ppm oil removal

Class 4:
38 °F pressure dew-point

Class 1:
1 micron particulate removal

**Classes per ISO 8573.1*

What other recommendations do you have for blow-molders?

Our employees are experienced in blow-molding applications and we can recommend many things for each installation. If an application sees pressure surges, we recommend smaller 260-gallon tanks right next to the blow-molding machine. For multiple air compressor installations, we also recommend using our Intercom panels, which can sequence up to 10 air compressors. This master controller will even out run times and signal an idled compressor to kick on if required. Our systems also come standard with mounted vibration dampeners so that the customer does not need to install a special concrete pad for the unit. By focusing exclusively on the PET market, AF has many helpful recommendations and built-in designs, which help the blow-molder.

Thank you AF Compressors for your insights.

For more information please contact Joe Mashburn, AF Compressors USA, tel: (770) 214-2241, email: joem@afusa.com, www.afcompressors.com

Real World Best Practices

by Hank Van Ormer

PET PLANTS USING BOOSTERS FOR HIGH-PRESSURE AIR

The use of high-performance boosters to raise low-pressure air (100 psig class) to high-pressure air (500–600 psig) for the blow-molders is very power efficient and offers good operating performance and reliability when well applied.

Selecting a Booster

How many stages? From a durability standpoint the booster should be selected to handle the required volume of air (scfm) and raise it to the final discharge pressure (nominal 550 psig) from the nominal inlet pressure (115 psig) with reasonable compression ratios per stage (2.5 to 3.5 ratios per stage). With the above example, the CR (compression ratios) would be:

- **Final Pressure** (550 psig +14.5 psig) = 564.5 psig ÷ Inlet pressure (115 psig + 14.5 psig) = 129.5 psig or 4.36 compression ratio (This equation makes no sense), which is somewhat high using a single stage unit for continuous industrial duty

- This is about 2.09 compression ratios each in a two-stage booster (square root of 4.36) and is very conservative and well applied.

Other Considerations — There are other considerations that the Booster manufacturer will consider in recommending a unit for this application such as:

- Rod load acceptability
- Proper valve action and operation
- Cooling capability

What Size Booster — What Basic Layout?

The size selection is dependent on the basic demand profile for example, are we going to apply one primary air compressor for each booster and separate low-pressure air compressors to serve the low-pressure system or put all the low-pressure air into one central low-pressure supply (headers & receivers) and allow the boosters to pull the air as needed with the remainder of the low-pressure air serving the low-pressure system.

- Dedicated primary air compressors to each booster offers a very safe design as the low-pressure air supply will always be there for the booster or both will be off. The booster has very little chance of receiving too low entry pressure entry air with potential imaging results. It probably will not have optimum power efficiency
- Properly installed, a well designed central low-pressure compressed air supply collected together offers a great deal of flexibility and ability to optimize both low- and high-pressure electrical energy operating costs
- Primary low-pressure can be selected for performance and suitability rather than have the size limited by the booster inlet capacity. Larger horsepower well applied three-stage centrifugals will generally be more power efficient than smaller units
- During emergencies low-pressure rental compressors can be tied in without affecting the high-pressure air input
- Efficient low-pressure air supply will also improve the operating efficiency of the low-pressure system
- Boosters can be selected on operating performance rather than convenient sizing. The most commonly used boosters for these applications would be two-stage, double-acting, horizontal-balance opposed water-cooled reciprocating compressors

Booster Size And Efficiency

Usually a larger unit will be more power efficient.

For example:

- A typical 150 hp class, two-stage 7" & 4" x 74" unit at about 485 rpm will deliver about 648 scfm (.82VE) at 143 BHP, at 600 psig (5.74 scfm/kw)
- A typical 300 hp class, two-stage 9" & 6" x 9" unit at 429 rpm will deliver about 1884 scfm at (.90VE) 291 BHP at 600 psig (8.202 scfm/kw)

The larger reciprocating unit has a better VE (Volumetric Efficiency) and overall is 30% more power efficient (5.74 scfm/kW ÷ 8.202 scfm/kW). With the flexibility of a central low-pressure supply the proper booster selection can have a very positive impact.

A single central low-pressure supply system requires careful piping and storage design. Be sure there is plenty of supply for both the low- and high-pressure requirements. All boosters should be equipped with low inlet pressure safety controls.

The following Table 1 shows the relative efficiency of a three-stage, low-pressure centrifugal primary combined with 9" & 6" x 9" booster compared to traditional four-stage centrifugal and four-stage double acting reciprocating unit.

REAL WORLD BEST PRACTICES

PET PLANTS USING BOOSTERS FOR HIGH-PRESSURE AIR

Comparison of Primary with Booster and High Pressure Ratings

	PRIMARY TO BOOSTER		ATMOSPHERIC TO HIGH-PRESSURE	
	THREE-STAGE CENTRIFUGAL	TWO-STAGE DOUBLE ACTING BOOSTER	FOUR-STAGE CENTRIFUGAL	FOUR-STAGE DOUBLE ACTING RECIP.
Model	Typical	9" & 6" x 9"	Typical	Typical
Unit Type	Centrifugal Three-stage	TS Double-acting	Centrifugal four-stage	Balanced opposed
Inlet Pressure (psig)	14.5 psig	115 psig	14.5 psig	14.5 psig
Full Load Horsepower (bhp)	421	291	855.8	624.7
Full Load Motor Efficiency (.me) (est)	.95	.945	.93	.93
Full Load Pressure (psig)	115	600	600	600
Full Load (input) kW @ 600 psig: Calculated	330.5 kW	229.7 kW	686.5 kW	465.6 kW
Full Load Specific Power (scfm/kW)	5.7 scfm/kW	8.202 scfm/kW	2.48 scfm/kW	3.31 scfm/kW
Flow Each @ Rated psig	1,884 scfm	1,884 scfm	1,704 scfm	1,543 scfm
Total Input kW Combined	560.2		686.5	465.6
Specific Power (scfm/kW) Combined	3.36 scfm/kW		2.48 scfm/kW	3.31 scfm/kW
Annual Electric Cost ($/scfm) @ 600 psig	$176.92 scfm/yr		239.71 scfm/yr	179.54 scfm/yr

Based on $0.07/kWh operating for 8,500 hours per year

Summary

Well-applied primary compressors and boosters deliver about the same operational efficiencies ($176.92 scfm/yr) as the four-stage double acting reciprocating high-pressure unit ($179.54 scfm/yr). The four-stage reciprocating units use 2.55 ratios per stage compared to the 2.09 CR per stage of the booster. Properly applied, both are well within limits.

Either of theses units are about 25% more power efficient than a typical four-stage high-pressure centrifugal under the same conditions. The centrifugal offers some other significant benefits in initial cost, projected maintenance cost and installation cost.

Qualifying this part of the application requires significant investigation. However, a properly selected and applied booster can be an excellent choice, as would any of the other options depending on the installation and maintenance situation.

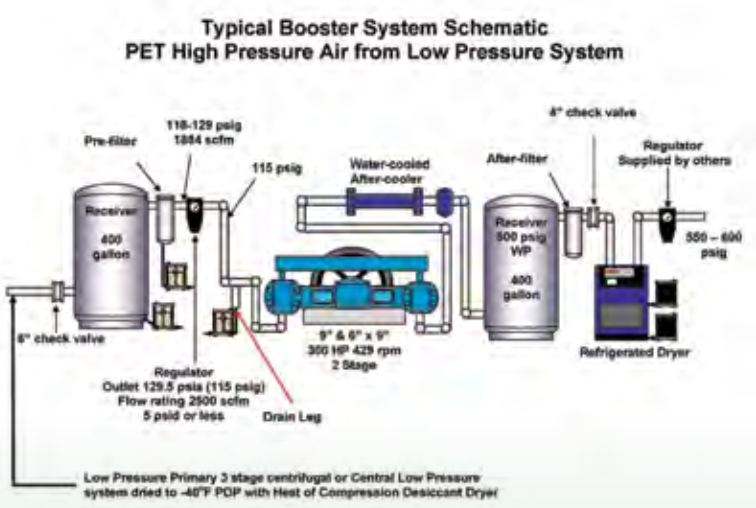
Installation Guidelines For Booster Applications

Check Valves

A high-quality check valve should be installed on the inlet to and the discharge from the Booster compressor.

The inlet check valve would be installed up stream of a pulsation tank or receiver tank on the inlet line to the booster. This will stop the pulses from entering the main distribution line from the centrifugals and having a negative effect on the controls. It will also protect the main air system from any high-pressure "back feed" if there are inlet valve problems with the Booster.

Installation Guidelines for Booster Applications



The discharge check valve, which should be installed down stream of a pulsation tank or receiver tank, will stop any high-pressure air from bleeding back into the booster when the machine unloads. This is an extra precaution in case of a leaking discharge valve on the booster.

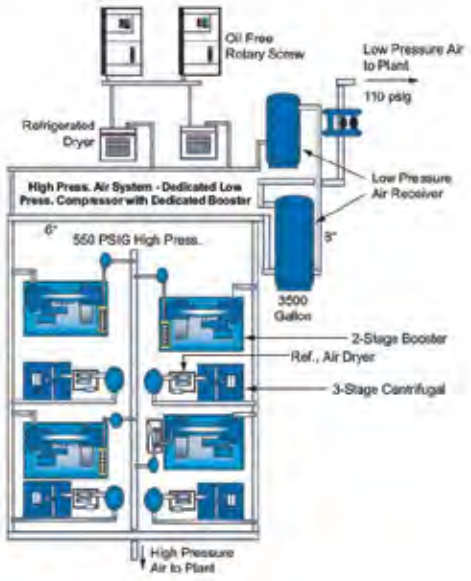
With the inlet check valve upstream of a receiver and the discharge check valve downstream of a receiver, correctly selected valves should not cause any abnormal maintenance problems. The receivers will dampen most of the pulsations going to and coming from the Booster compressor.

Check Valve Example — (Be sure to check with vendor)

Inlet (low-pressure) check valves:

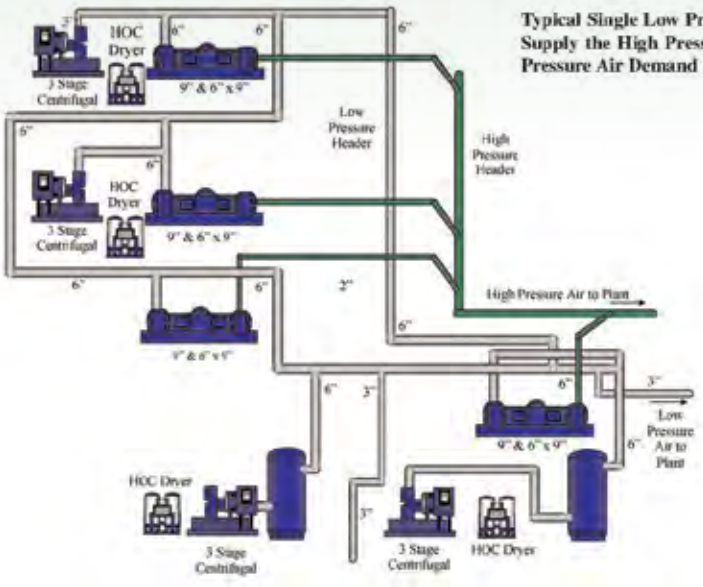
- **Valves may be designed for 2 psig on 2000 scfm of air at 134.5 psig of pulsating flow**
- **Discharge (high-pressure) check valve**
- Valves may be designed for 2.1 psig on 2000 scfm of air at 614.7 psig of pulsating flow
- Materials — as recommended by vendors

Typical High Pressure System with Dedicated Primary High Pressure Compressor. Separate Compressor for Low Pressure System.



REAL WORLD BEST PRACTICES

PET PLANTS USING BOOSTERS FOR HIGH-PRESSURE AIR



Typical Single Low Pressure Collector Header to Supply the High Pressure Boosters and the Low Pressure Air Demand

NOTE: These schematics are taken from actual compressed air audits we have performed. They are not to be construed as recommending particular pipe sizing, receiver sizing and location etc.

Pulsation Tanks (Receiver Tanks)

The receiver tanks will slow down the air and dampen the pulses of the Booster Compressor. On a Reciprocating compressor there is about a 10% change in pressure on the inlet and discharge of the unit. This is caused by the inlet air filling the cylinder and by the discharge air leaving the compressor.

The receivers allow the pressure changes to occur in them instead of the piping. This is critical on the inlet to the booster to not allow the pulses to possibly back pressure the centrifugal and cause it to surge. The discharge receiver will allow the regulator to receive a relatively stable flow of air with minimal fluctuations in pressure.

Typical High-Pressure System with Dedicated Primary High-Pressure Compressor. Separate Compressor for Low-Pressure System.

Air Receivers Example

Inlet (low-pressure) — 400-gallon vertical receiver with a 200 psi MWP with a 200 psig rated safety valve — gauge and automatic condensate drain

> **Note:** 200 psig is standard in the 400-gallons class and is recommended in case of back pressure problem.

Discharge (high-pressure) — 400-gallon vertical receiver with an 800 psi MWP, with a 800 psi rated safety valve, gauge and appropriate automatic condensate drain (high-pressure)

For Final Specification

There should be an inlet and discharge regulator installed in the booster system.

The inlet regulator is there to provide a consistent pressure to the booster. If the pressure is too low it will create too many compression ratios and potentially cause damage. If the inlet pressure is too high it may cause internal damage to the unit and excessive heat.

This also allows the piping and receivers to create effective storage to handle random spike demands caused by the many pulses per minute in both directions.

The discharge regulator is there to provide a constant pressure to the process. The constant pressure will allow the process to operate more effectively. With the regulator in place, operation personnel can effectively "dial in" the best pressure in which to operate without changing the settings on the compressor. This regulator may also be installed at or near the process or blow-molder rather than near the discharge of the receiver or check valve.

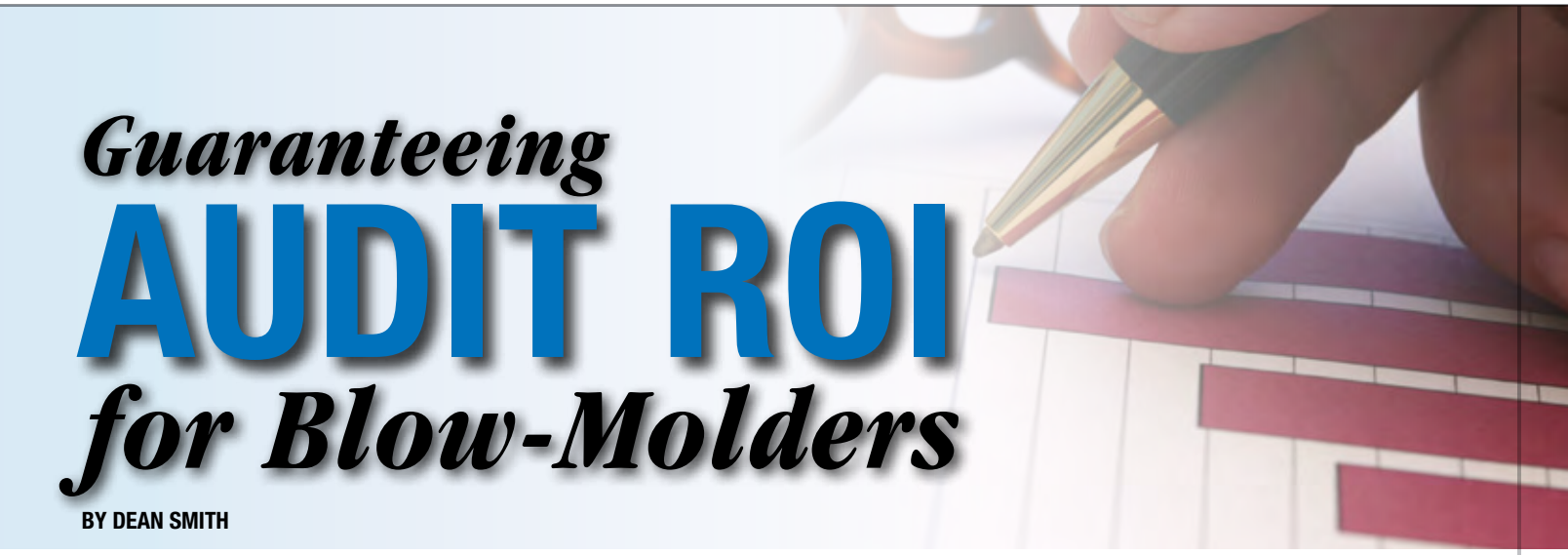
The inlet regulator should be pilot operated. This gives a much finer response time over other types. It may be a rotary vee notch valve with pilot operated actuator.

Inlet air to the booster should be dry and clean. With centrifugal or oil-free rotary screws, we usually recommend heat of compression from descent twin tower dryers which will dry the incoming air enough to not require any further drying or cooling of the air delivered to the high-pressure systems.

The schematics below show two different high-pressure booster installations.

The heat of compression dryer will deliver very dry air (to -40 ˚F PDP) with little or no significant electrical energy use.

For more information contact Hank Van Ormer, tel: 740-862-4112, email: hankvanormer@aol.com, www.airpowerusainc.com



Guaranteeing AUDIT ROI for Blow-Molders

BY DEAN SMITH

CEO's and CFO's are looking for return-on-investment (ROI) guaranties on compressed air energy-saving projects. These executives are paid to maximize shareholder returns and must choose wisely on how to allocate capital. They must often choose between deploying capital on production projects or facility projects where energy and cost-savings can be generated.

Dean Smith

Production projects are often chosen because it may be felt that attaining the ROI is more certain. A new production line can be expected to generate certain returns. Facility energy-savings projects sometimes do not deliver the expected returns. This article outlines a three-step process to guarantee the CEO or CFO the ROI's promised in a compressed air energy saving project.

Step 1: Analysis and Quantification of Savings and Costs

Guaranteeing savings is much different than guaranteeing ROI. Savings can be attained on the compressed air system at an unacceptable cost and therefore ROI. CEO's and CFO's want proof that ROI's will be attained and that they are verified. There have been two issues, over the years, which have left some end users with a level of frustration with compressed air audits:

1. The first has been that although the auditors identified opportunities for savings, the required actions were not taken in the facility to implement them. This leaves people pointing fingers at each other as to whether the auditor or the facility didn't get the work done. The result is the same — savings are only realized on paper and the ROI is not delivered.

2. The second frustration is that the audit is implemented but verification is not done over time. The CEO does not know if the savings are continuing or if the compressed air system degrades over time towards the original cost levels — therefore eliminating the promised ROI.

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

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GUARANTEEING AUDIT ROI FOR BLOW-MOLDERS

Step 1 involves accurately identifying measuring savings and quantifying the costs required to generate the ROI. The key is to focus on the costs involved with implementing and verifying the project. It is important to partner with the company and identify what resources the company will make available to implement the project. The Analysis and Quantification Step must detail the costs involved with ensuring ROI and detail the verification dates and process.

Normally, the goal is to be successful in one facility of the corporation and then to roll out the model to the rest of the factories in the organization. By having a detailed Analysis and Quantification Step 1,which includes all the costs involved to prove that ROI has been attained, the buy-in and support of senior management will be greater.

Measuring Savings

Most facilities do not design their compressed air systems based upon an understanding of the ranges of demand and the rates (or speed) of change in demand. Almost all facilities design their compressed air systems around maximum air-flow demands and maximum air pressure requirements. This is where the big opportunity exists for improvement. What and how you measure becomes the key factor when measuring savings.

1. **Measuring Power:** We do measurements to know a compressors' true kW power consumption loaded and unloaded. We do not use product name-plate data. This is important. We are measuring amps to determine power factors and motor efficiencies

2. **Measuring Pressure:** We measure pressure and the rate of change of pressure. Know the storage values in the system and its' rate of change. This gives us a handle on the production side and the demands being placed upon the air compressor system

GUARANTEEING AUDIT ROI FOR BLOW-MOLDERS

The Three Steps for ROI Guarantees

Step 1:

Analysis and Quantification of Savings and Costs

Step 2:

Execute the Project and Verify the ROI

Step 3:

Maintain the Gain and Monitor ROI

3. **Measurement Method and Location:** We precisely measure how much storage there is in the piping, storage tanks and all other parts of the system. We use pressure loggers to measure pressure in the headers and general system pressure. For high-speed loggers, we use pressure transducers where we can vary the speed and still provide output data. These pressure transducers will take 25 measurements a second — for a whole hour.

   a. We usually measure at the exit of the compressor rooms' main header pipe so we can see what pressure is coming out of the compressor room and their start/stop behavior

   b. The signal location within the compressor is another measurement location. This allows us to look at the behavior of an individual compressor behavior in start/stop mode. Customers are often amazed to learn that their air compressors are ramping up because of a leak in the small solenoid drain valves placed on the after cooler separators of the air compressors

   c. Measure pressure change on production equipment. Pneumatic systems are often undersized or have failed pressure regulators. Pneumatic circuit tubing can also cause changes in pressure

Analysis of Costs in a Project

This analysis must look at the costs required to improve the compressed air system and to modify production equipment. When improving the compressed air system, we are usually reconfiguring and controlling the system better — rather than buying new equipment. In blow-molding installations, we normally see equipment costs, which will include additional air storage, automation systems to control multiple air compressors and variable speed drive (VSD) air compressors to more efficiently manage the variations in demand. New air compressors are required only 15–20% of the time and are normally related to production expansions.

Production area costs lie in the process equipment, which has been improperly designed (for the existing working conditions) from the pneumatic system standpoint. Injection and extrusion blow-molders are often sped up to 50% greater speeds than the pneumatic systems were designed for. The blow-molding machines often are blowing bottles two to three times bigger than the pneumatic circuits were designed for. This causes both pressure drops and air quality problems within the process equipment. In PET Stretch Blow equipment, we see pressure changes from 60–70 psig all the time. We've seen equipment, which should be at 600 psi, experience changes that take it to 500 psig. Pressure restrictions of four to five bar (57 to 72 psig) are very common. Air consumption goes up and the pneumatic circuits simply can't handle it. The facility is then forced to increase overall air system pressure to make up for it.

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You can explore promising new technologies, compare energy and facility management products and services, alternative energy options, and learn about innovative project implementation strategies. The multi-track conference covers a variety of topics, many specific to the region.

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The conference is designed to provide hands-on, up-to-the-minute information you can use right away to improve your energy management program, including distributed energy opportunities, renewables, power quality issues, thermal distribution systems, new tools for maintenance and overall facility management, and creative project financing options. Case studies will detail successful application of new technologies and other innovative cost management strategies. You'll also hear insightful commentary from leading experts on what the future holds and how best to prepare for it.

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GUARANTEEING AUDIT ROI FOR BLOW-MOLDERS

To upgrade these pneumatic circuits, the blow-molding machine must be taken off-line, which results in lost production time. This cost must be factored into the project costs and can represent up to 10% of the overall cost to implement the project.

Fixing these problems can and do greatly improve production outputs of blow-molding machines. The cost and benefits to address this must be part of the analysis.

Step 2: Execute the Project and Verify the ROI

Execution windows usually range from 8 to 16 weeks from the date of commitment. Project execution is where a high degree of flexibility is required. Each client has different levels of project management and engineering capabilities. We have to customize a project execution schedule taking this into account. Some corporations want a turnkey project while others just want project management and engineering guidance. The simplified project execution steps include:

a. Visit the facility and execute the full audit

b. Develop a project engineering schedule during the audit visit

c. Work with contractors and client personnel on project implementation. Partner with the customer in this process

Step 3: Maintain the Gain and Monitor the ROI

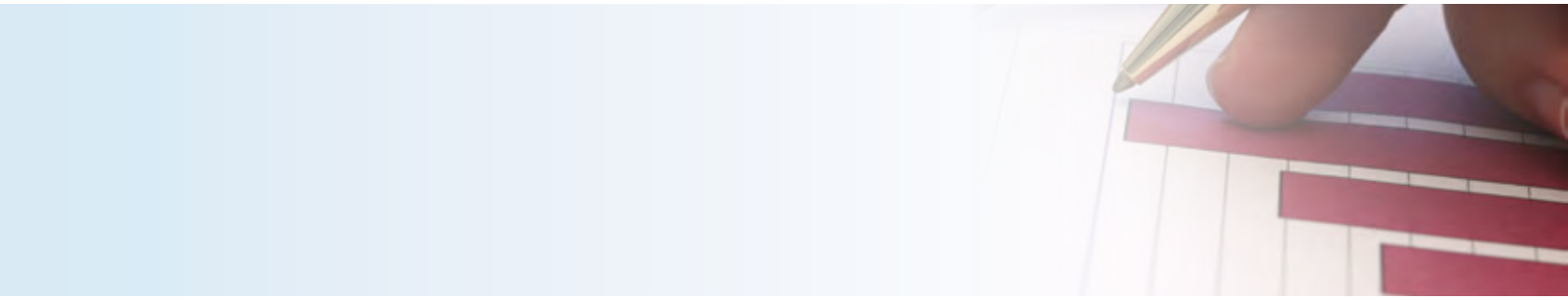
After the project is executed, the focus turns to verifying and maintaining the ROI. Over the agreed-upon ROI project lifetime, we monitor and measure the new system performance. We monitor dozens of facilities every day and track their energy consumption. We submit monthly reports to customers and normally hold quarterly reviews of how the system is performing versus the ROI expectations. If negative performance variations occur, we go to the facility to get the performance back on track.

One decision by a machine operator can get the ROI performance off-track and this must be monitored. After one year, the customer is normally trained on how to monitor and manage the system themselves. We train them on the common issues and how to correct them. This "ROI Monitoring" can go on for as long as the customer wants. Some want to take it over themselves while others want us to manage it for them. The key point here is that until the CEO/CFO is satisfied that ROI has been achieved, the project is not over.

Summary

This three-step process provides CEO- and CFO-level executives at large corporations with the assurance that they will see an ROI on a facility project involving their compressed air systems. It can take a couple of years to execute projects at all the plants of a corporation. This three-step process of (1) analysis and measurement of savings and costs (2) project execution and ROI measurement and (3) maintaining the gain and monitoring the ROI, ensures it is a rewarding experience for the corporation.

For more information contact Dean Smith, iZ Systems, tel: (404) 307-6836, email: dsmith@izsystems.com



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Compressed Air Best Practices is a technical magazine dedicated to discovering **Energy Savings** and **Productivity Improvement Opportunities** in Compressed Air Systems for specific **Focus Industries**. Each edition outlines "Best Practices" for compressed air users — particularly those involved in **managing energy costs in multi-factory organizations**.

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

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  - B. Audit case studies and "Best Practice" recommendations
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MANAGING VACUUM PRESSURE DIFFERENTIAL

BY DOCTOR VACUUM

Where there is flow, there is restriction. Vacuum systems are not an exception to this rule and it is important to know how restricted airflow, through a vacuum distribution system, can affect your energy bill. A little known fact is that pressure differential, also called pressure loss, is the single largest contributor to elevated energy input in vacuum systems. Maintaining pressure differentials within reasonable limits keeps your vacuum system operating costs in line with industry norms.

Pressure differential, also called pressure loss, is the single largest contributor to elevated energy input in vacuum systems.

Pressure differential is simply the difference in vacuum from the point of use to the inlet of the vacuum pump. As air (or any other gas) flows through a distribution syste m, there is friction along the inner pipe walls that creates pressure differential. In addition to the pipe itself, other components can and will contribute to the overall problem. Inlet filters, point-of-use filters, receivers, condensers, isolation valves and check valves can all be suspect especially if any of these components are undersized or misapplied. Undersized inlet filters or inlet filters that are loaded with particulate are especially notorious for adding differential and in vacuum systems it is not always evident that an issue exists. Also note that 90º elbows, pipe T's and pipe reducers are necessary to some degree but can magnify the condition when used in excess.

Calculating the total pressure differential is easy — take the reading at the inlet to the vacuum pump and subtract the reading at the point-of-use to get the aggregate pressure loss. Much more difficult is defining which individual components contribute most to the vacuum loss and even more significant is determining how to correct each component in a way that makes economic sense. This last statement is most important because it is not prudent to make expensive corrections to a distribution system that will provide only marginal returns. It is essential to identify and repair only those issues that can boost productivity and reduce superfluous energy expense.

Systems that operate at higher vacuum will have more waste in energy cost as a result of pressure differential than systems that operate at lower vacuum. This is not to say that low vacuum systems cannot be optimized, only that the relative effect is greater at the higher vacuum levels. For example, if we compare the additional operating costs for a 3" HgV pressure differential in three different vacuum systems operating at cascading vacuum levels we can easily calculate the additional flow requirements. Note that a 3" HgV pressure differential is very common in real world production vacuum systems. Let's assume that the three systems are operating at 12" HgV, 20" HgV and 24" HgV respectively. The 12" HgV system will require the supply vacuum pump

to operate at 15" HgV to overcome the pressure differential. Therefore, this system needs a vacuum pump that is 20% larger than would be necessary if the pressure differential were not present. The 20" HgV system will require the supply vacuum pump to operate at 23" HgV and this vacuum pump has to be 43% larger than necessary. The 24" HgV system requires the vacuum pump to operate at 27" HgV, which means that it must be over 100% larger than necessary.

These additional flow requirements translate directly into additional energy requirements making this an easy target for kilowatt reduction programs. It is also important to note that even if the existing vacuum pump is kept in place after distribution system modifications are made there will be an increase in vacuum force at the point-of-use. In many cases this translates into an increase in production machine speed or a pick-up in product quality. There are a tremendous number of production vacuum systems that have this level of opportunity and are experiencing issues related to energy waste or are having vacuum supply issues at production machinery.

There are many reasons for the present condition of production vacuum distribution systems. One issue is that many vacuum systems were designed with compressed air principles in mind. In comparison to compressed air piping, vacuum pipe diameters need to be very large. A typical 100 horsepower compressed air system with 300 feet of pipe would require a distribution pipe diameter of about 3". On the other hand, a typical 100 horsepower vacuum pump would require pipe diameters of at least 6" but more likely 8" to keep pressure differentials within a reasonable range. It is not uncommon to see properly sized production vacuum headers in average size facilities that are 12" in diameter and greater, especially in the process industries.

There are a number of design principles that can assist in keeping vacuum differential as low as possible. Using smooth walled pipe, installing large radius elbows, keeping debris and particulate out of the distribution system and sizing components such as inlet filters so that pressure differential is low even under heavy particulate conditions are a few ideas. While there will always be some pressure differential in the system, the key is to keep it as low as possible so that its ongoing cost does not significantly hurt the bottom line. If you are unsure of the condition of your vacuum distribution system, get an evaluation done to determine where the opportunities lie and what energy reductions are possible.

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

"A 3" HgV pressure differential is very common in real world production vacuum systems."

Are you taking full advantage

BY CHRIS LANDIS

Put advancements in pneumatic valves to work for your organization

Pneumatic valves have come a long way since the development of the compressor over a century ago. Starting with large manual and mechanical valves, they migrated to individually wired electric solenoids and ultimately ended up with plug-into-the-base electronics allowing for a single multi-pin connector or fieldbus installation. Today's valves are smaller, faster and more advanced than their predecessors and offer many advantages that can be easily overlooked. With advancements in ISO valve standardization, collective wiring solutions and diagnostic capabilities, both end users and original equipment manufacturers (OEMs) are seeing significant cost reductions resulting from multi-vendor support, wiring simplification and decreased machine downtime.

The International Organization for Standardization (ISO) specifications 15407 and 5599 offer valve users protection against ever changing business conditions and product obsolescence, which are often the cause of vendor issues. These industry standards dictate the size and location of the valve porting, base porting and mounting screws, as well as the electrical connector location, size and wiring, if utilized. By migrating away from proprietary valve mounting patterns to a completely standard and interchangeable pneumatic and electrical ISO pattern, companies are able to ensure multi-vendor support on a global scale. Gone are the days of regionally based vendors undercutting prices at OEMs with hopes of high MRO prices at the end user facility. ISO interchangeability and consistent cost structure ensure consistent pricing levels.

Collective wiring solutions, especially when integrated with a fieldbus solution, provide an elegant mechanism to consolidate solenoid wiring into a single "collective" connection on the valve manifold. This methodology offers significantly reduced cost and complexity of the machine. Industrially rugged electrical connections, combined with advanced sealing technology, allow the valve manifold to be moved out of the control cabinet to point-of-use application located near the pneumatic process. This eliminates long tubing runs and corresponding delayed responses in pneumatic operations. When integrating a fieldbus solution, there is a sharp reduction in the number of components on the bill of material as terminal strip laden junction boxes and control cabinets are reduced to simple connections. Now, two cables — one communication and one power — can handle the work-load of hundreds while eliminating home-run wiring and long conduit runs. Large machines can be broken down for shipment and reassembled with an absolute minimum of labor since the wiring is bus connected with only two cables.

Finally, diagnostic tools like short circuit detection, confirmation of signal and status LED lights offer advancements in troubleshooting and maintenance. When combined with an integrated fieldbus solution, status bits from advanced valve driver modules are able to quickly alert an industrial PLC when a short circuit is detected on any valve solenoid, which is the most common failure mode of an electric solenoid. With user programming, the status bit change can be turned into a detailed error message stating, "Valve Number four Must Be Replaced with a Two-Position Double Solenoid ISO 15407-2 Valve." Also available from advanced valve driver cards is a status bit indicating that the current has been sent to the solenoid. This functionality acts as a double check to confirm the PLC program issued by the command, that the fieldbus network communicated the request and that the valve driver module had the correct working voltage and applied it to the solenoid. This is a way to confirm the command was executed by all components in the system, as expected. Status LED lights offer a fast, visual indication of the component status. Malfunctions in the power source, fieldbus status and modules can be detected without queries to the PLC. With some upfront programming, these types of feedback will alert the user to a potential issue and offer a way to stop production before bad parts are made, improving both scrap rate and machine downtime costs.

# of pneumatic valve technology?

Benefits to OEMs

The benefits offered to OEMs regarding advancements in ISO standardization, collective wiring solutions and diagnostic capabilities are tremendous. ISO standardizations with multi-vendor support ensure lead-time is no longer an issue. Regional business issues sustained by one vendor will very rarely affect the performance or output of another. With many manufacturers offering complete ISO valve product lines, including discretely wired valves, collectively wired valves, sandwich regulators, flow controls, transition plates, English threads, metric threads and a variety of voltage and fieldbus options, designers can work with confidence knowing all their needs can be met. And with the ISO specification governing valve sizes ranging from 18mm up to 64mm wide, a complete range of flow rates are available.

When utilizing collective wiring solutions with fieldbus, the time required to measure, cut, strip, terminate and label a solenoid is eliminated, equating to a savings of three minutes per connection. When analyzing a standard hard-wired system where each solenoid is wired individually, the time-savings become more apparent. A standard solenoid will have three leads going from the valve to a junction box, one for positive voltage, one for common and one for ground. Once back at the junction box, most machine builders group all the common voltage lines together as well as all the ground lines together for the run from the junction box to the control panel to reduce wiring. Thus, there can be four connection points for each solenoid on the valve in the system: one at the solenoid, one at the valve side of the terminal strip in a junction box, one at the control panel side of the junction box and one at the PLC output card inside the control panel. Considering many fieldbus equipped valve manifolds offer a 32 solenoid capacity, this could have an assembly time reduction of over 13 hours!

CONNECTION LOCATION	TYPE OF CONNECTION	CONNECTIONS	TIME
Valve Connection	(3 valve leads) x (32 valves)	96	288 min
Junction Box — Valve Side	(3 valve leads) x (32 valves)	96	288 min
Junction Box — Control Panel Side	32 outputs + common + ground	34	102 min
Control Panel	32 outputs + common + ground	34	102 min
	Total	**260**	**780 minutes (13 hours)**

Wiring savings of a 32-station valve manifold, at three minutes per connection.

ISO Specifications 15407 and 5599 offer pneumatic valve users protection against ever changing business conditions and product obsolescence

ARE YOU TAKING FULL ADVANTAGE OF PNEUMATIC VALVE TECHNOLOGY?

Point-to-point testing time is also reduced proportionally to the reduction in solenoid leads. With many valve manufacturers integrating both digital and analog input and output capabilities into their fieldbus equipped valve manifolds, many additional terminal strips and wiring runs can be reduced, in the same three minutes per connection. Many manufacturers and distributors offer completely assembled, pneumatically and electrically tested manifolds, reducing the potential for errors.

Now consider the cost of the conduit runs, which need to be cut, threaded, bent, supported and installed at an estimated six minutes for each operation. With one bend, and two threaded ends, a standard 10 foot long piece could add up to 36 minutes. When you consider the time to layout, cut, drill and assemble the junction box or main panel, estimated at 45 minutes each, along with two 32 solenoid valve manifolds and 20 feet of conduit, you have just reduced your machine assembly time by 28 hours. Using an estimated fully burdened labor rate of $65 per hour, the labor savings approach $2,000. Remember, this does not include the cost of the components no longer needed.

COMPONENT	QUANTITY	TIME SAVINGS	TOTAL SAVINGS
32 Solenoid Valve Manifold	2	780	1,560 min
Junction Box	1	45	45 min
Control Panel	1	45	45 min
10' Conduit Run	2	36	72 min
		260	**1,722 minutes (28.7 hours)**

Total sample machine time savings.

Additional cost savings can be realized by OEMs as a result of valve enhancements. Point-of-use valve installations offer easy tear down and rebuild of machines when moving from the OEM floor to the end user facility, potentially reducing reinstallation time at the end user site by 50%. As mentioned before, simple twist-to-connect cordsets replace extensive junction boxes or bulky multi-pin connectors. The total wiring reduction of collective wiring solutions offer a lower probability of wiring errors. This wiring reduction,along with the elimination of junction boxes and conduit runs, will translate into simplified engineering drawings, saving additional time. And with point-of-use application, the ability to use pre-designed layouts or reuse layouts from other projects becomes much easier, as the input and output modules are not located inside the panel.

PLC manufacturers are beginning to incorporate vendor specific profiles into their software resulting in easy controls startup of valve fieldbus solutions by selecting module profiles from a pull-down list. These profiles can significantly reduce configuration time by eliminating the need to search through maintenance manuals and instruction sheets for fieldbus variables necessary to add collective wiring manifolds to the network. This eliminates the potential to enter an incorrect variable and corresponding time required to troubleshoot the mistake.

Benefits to End Users

Benefits aren't just limited to OEMs, as end users are able to capitalize on advancements of ISO standardization, collective wiring solutions and diagnostic capabilities. OEE (Overall Equipment Effectiveness) is improved with ISO valve standardization by minimizing machine downtime. By using the diagnostic capabilities of an integrated fieldbus solution, a faulty valve can be identified and an appropriate ISO style replacement given. MTTR (Mean Time to Repair) is reduced with a simplified ISO 15407-2 or 5599-2 design requiring the removal of only two to four fasteners and no cables or wiring. Many advanced valve driver modules offer auto device replacement, clearing the error status bit automatically, once the worn valve has been replaced. No programming or controls engineering assistance is needed. This is also true of many integrated input and output modules often attached to the same valve manifold (check with your supplier for guidelines). Additionally, users will have reduced potential for down time in their facility due to the reduction of components, such as junction boxes, terminal strips and conduit runs resulting in a reduced bill of material and hence a reduced opportunity for failure. Crib inventory is reduced as proprietary valves, and consequently specific vendor nuances as well, are eliminated.

Furthermore, end users are likely to see a cost savings benefit passed on by their OEMs in the form of more competitive bids resulting from the labor and material reductions of collective wiring pneumatic valves. You can expect manufacturing time to be reduced by the time savings associated with collective wiring, as end users may see a reduced lead time from their vendors, with a potential further reduction of expedited costs and concerns over system installation deadlines.

Point-of-use valve installations integrated with fieldbus make it significantly easier to expand collective wiring valve manifolds for last second machine enhancements as well as machine upgrades performed after initial installation. There is no need to have individual leads running back to the junction box terminal strips or control panel, resulting in significant time-savings for engineering and assembly. For valve manufacturers incorporating fieldbus with input and output capability on their point-of-use valve manifolds, it is easy to add I/O to the machine. There is no need to worry about control panel spacing and whether or not their will be room to expand because the system is located outside of the panel.

With many end users adopting Lean principles of manufacturing and continually striving to eliminate waste and improve material flow, collective wiring offers the additional benefit of easy relocation of manufacturing centers. With the elimination of junction boxes, disassembling a station can be as easy as disconnecting a few cordsets and reconnecting after the move. The control panel and overall machine size will be reduced because valve manifolds can be located conveniently around the machine, rather than in one large, central location.

Whether your organization is an OEM or an end user, there are a myriad of ways to capitalize on pneumatic valve advancements like ISO standardization, collective wiring solutions and diagnostic capabilities. The next time an opportunity to specify a pneumatic valve solution arises, think about specifying an ISO standard with integrated fieldbus. Standardizing on a standard will allow you to take advantage of global multi-vendor support and fair MRO pricing structures. If rising labor costs and wiring complexity are causing increases in machine cost and maintenance complications, look into the ever-advancing capabilities of collective wiring solutions and diagnostic capabilities. Improved profitability, decreased machine build times and enhanced diagnostics are all possible with today's pneumatic valve solutions.

For more information please contact Chris Landis, Product Sales Manager — Valve/Vacuum, Parker Hannifin Corporation, Pneumatic Division, tel: (269) 629-5000, Email: CLandis@Parker.com, http://apps.parker.com/pneu/simplify/

Are You

BY RICH HORWATH

> "Only 4% of management leaders could be classified as strategists."

Until now, looking into someone's soul is about the only way we've had to guess at whether or not someone is "strategic." In many organizations, it is assumed that senior executives are strategic and lower-level employees are not. As you might imagine, strictly using someone's title to determine their strategic ability is as accurate as using a Hollywood star's popularity to determine their knowledge of political issues.

Leadership research by the American Management Association has shown that the most important competency for a leader to possess is the ability to develop strategy. Unfortunately, when researchers examined leaders at all levels in organizations, they found only 4% could be classified as strategists. According to the Institute of Directors in London, the wide gap between the importance of strategic thinking and the percentage of leaders that actually are strategic can be attributed to the fact that 90% of executives at the vice president level have had no training to become competent strategists.

There are three defining principles that great strategists continually apply to their business in order to enable them to outperform their competition:

Strategic?

1. Create Differentiation

Differentiation for competitive advantage in business has its roots in science. In 1934, Professor G.F. Gause published the results of a landmark study. In the study, he placed small animals in a bottle with an ample amount of food. If the animals were of the same genus and a different species, they were able to live together peaceably. However, if the animals were of the same genus and the same species, they were not able to coexist. This led to the Principle of Competitive Exclusion, which states: No two species can coexist if they make their living in the identical way.

Open the newspaper and read about the struggling companies — it's a good bet that one of the reasons they struggle is because they fail to pay heed to the Principle of Competitive Exclusion. They are stuck doing the same things in the same way as their competition. Jeffrey Immelt, Chairman and CEO of General Electric, has written, "GE must look different…act different…be different…to excel in the years ahead." Notice he didn't write that GE must be "better." He specifically chose the word "different" and used it three times to emphasize his company's understanding that the road to success in business is paved by differentiation from the competition.

What do Johnny Cash and the Mini-Cooper automobile have in common? Johnny Cash didn't have the best singing voice and the Mini-Cooper isn't the highest performance automobile on the market. However, they have both been remarkably successful, not because they were "better," but also because they were different from their competition in ways their core customers valued. Strategic leaders are continually asking two questions:

What activities are we performing differently than the competition? What are the similar activities we're performing in a different way than our competition?

2. Focus Resources

Focus demands that we have the discipline to allocate resources to specific areas and activities, rather than spread them evenly across the business. Focus comes from the ability and willingness to make tradeoffs. Tradeoffs are about choosing one path and not the other, and they involve incompatible activities — more of one thing necessitates less of another. In most industries, one can choose to be the leader in researching and developing new products or the leader in providing low-cost goods, but cannot do both without bearing major inefficiencies.

Making tradeoffs is one of the most difficult tasks for most managers, and the result is that they rarely do make the necessary tradeoffs. Instead, they hedge their bets and abide by the adage of "trying to be everything to everyone." Therefore, good leaders cannot afford to be like Farmer Brown. In the morning, Farmer Brown hops on the tractor and spreads fertilizer evenly across the crops in hopes that everything will grow. Strategic leaders don't spread their resources evenly across the business in hopes that everything will grow as well. If they do, their business will ironically end up in the same condition as Farmer Brown's fertilizer.

Strategy is as much about what you choose not to do, as it is about what you do. Focus requires tradeoffs and tradeoffs require risk. Those leaders not willing to take risks will never make it to the top of the strategic summit. Two questions to begin thinking in terms of focus: What potential offerings have we chosen not to provide to customers? Which potential customers have we chosen not to serve?

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ARE YOU STRATEGIC?

3. Design Systems

From the coral reefs of Cozumel, Mexico to the Amazon rainforests to our own bodies, life is comprised of systems. Strategy is no different. Great strategies are comprised of a system of activities that tightly fit together and act as a shield to competitors attempting to copy your successful business. As an example, if there is only one activity comprising a strategy, the chance a competitor can successfully copy it is relatively high, around 90% or .90. With three activities comprising the strategy, the probability of a competitor successfully emulating the strategy drops to 73%. Creating a system of strategy involving 10 activities significantly diminishes the competitor's ability to copy the leader.

While the aim is not to have dozens of activities simply for numerical sake, thoughtfully creating an interconnected web of complementary activities is of great value in maintaining a differentiated strategy from the competition.

Strategic leaders ask two questions relative to their system of strategy: How many activities currently comprise the strategy? What are the three to five strategic themes that are going to be the centerpieces of the strategy system?

# of Activities	Numerical Representation	Probability of competitor match
1	.9	90%
2	.9 x .9	81%
3	.9 x .9 x .9	73%
4	.9 x .9 x .9 x .9	66%
10	$.9^{10}$	35%

Soul Searching or Truly Knowing?

Organizations can continue to operate in first gear with only a handful of people strategically contributing to the business, or they can tap into the deep reservoir of insights that are waiting to be awakened in managers at all levels. Ensuring that managers are leading with the three principles of strategy — differentiation, focus and a system — will go a long way in raising the strategic competency of your organization.

About the Author:

Rich Horwath is an author, speaker and strategy trainer who helps organizations develop their leaders' strategic thinking skills to achieve competitive advantage. He is the president of the Strategic Thinking Institute, a former Chief Strategy Officer and professor of strategy at the Lake Forest Graduate School of Management. Rich is the author of three business strategy books, including his most recent, "Strategy Espresso." For more information, contact Rich at (847) 756-4707, or to receive a free copy of his monthly e-publication Strategic Thinker, visit www.strategyskills.com.

RESOURCES FOR ENERGY ENGINEERS

TRAINING CALENDAR

TITLE	SPONSOR	LOCATION	DATE	INFORMATION
Compressed Air Management	Power Supply Industries	Fenton, MO	4/8/2008	www.psiind.com
Fundamentals of Compressed Air	Compressed Air Challenge®	Omaha, NE	5/6/2008	www.compressedairchallenge.org
Advanced Management of Compressed Air	Compressed Air Challenge®	Omaha, NE	5/7/2008	www.compressedairchallenge.org
Compressed Air Management	Power Supply Industries	Fenton, MO	8/19/2008	www.psiind.com
Best Practices in Compressed Air	World Energy Engineering Conf.	Washington D.C.	10/2/2008	www.energycongress.com
Compressed Air Management	Power Supply Industries	Fenton, MO	11/4/2008	www.psiind.com

Editors' 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 Ultrasonic Leak Detection System

UE Systems has introduced the new Ultraprobe® 3000 ultrasonic leak detection system. This versatile inspection instrument is designed for cutting energy waste and improving uptime while saving money and improving the environment. The Ultraprobe® 3000 has also been labeled a "green" instrument for its ability to accurately detect energy waste, helping to reduce a plant's carbon footprint. Understanding the importance of energy efficient plant operations, UE Systems is confident the 3000 will significantly impact energy conservation by locating compressed air and steam trap leaks as well as faulty steam traps, which can lead to millions of dollars in plant savings this year.

This digital instrument, which is fully equipped with a wide, dynamic sensitivity range and "spin and click" sensitivity dial, has a 16 segment bar graphic display panel that showcases sensitivity level, storage location, storage location number, and battery level. It also offers 400 memory locations to hold all of the operator's text data. Other features include scanning and stethoscope (contact) modules, noise-isolating headphones, calibrated decibel readout, rubber focusing probe and a storage entry area. Optional accessories including a long range module to double leak detection distance, HTS holster set and a RAS-MT magnetically mounted transducer and cable recharger kit allow operator's to extend the probe in hard to reach areas — with one button to control everything.

UE Systems
(914) 592-1220
abandes@att.net
www.uesystems.com

PRODUCT PICKS

New Booster Compressors to 650 psig

Kaeser Compressors has expanded its proven line of booster compressors. Providing pressures to 650 psig and flows to 685 cfm fad, these units are a convenient, economical way to boost existing plant pressure for PET bottling systems while eliminating the need for expensive, separate high-pressure systems.

Mounted on heavy-gauge base plates with anti-vibration pads, Kaeser boosters do not require special foundations and fastenings. Standard N Series High-Pressure compressors come complete with TEFC motor and starter, as well as aluminum cylinder heads and finned copper cooling pipes for efficient aftercooling. Booster Extra Pressure (EP) compressors include precision manufactured, two or three cylinder pumps with 100% duty cycle and a new forced lubrication system with continuous, full filtration. These features, combined with an automatic v-belt tensioning device, provide reliable operation and extended equipment service life.

Kaeser Compressor
(800) 777-7873
www.kaeser.com

New ISO 15407-1 Pneumatic Valve & Fieldbus System

The Pneumatic Division of Parker Hannifin Corporation has introduced Isys HA (26mm) and HB (18mm) ISO 15407-1 valves. The new valves are equipped with a central 4-pin M12 connector that provides a single electrical connection for single and double solenoids via a cord set linked to an M12 fieldbus output module or I/O distribution block. The cord set reduces wiring time because it eliminates conduit runs and wire pulling while improving line management.

Isys M12 valves were developed in direct response to industrial requirements for a rugged stainless-steel connector with IP65 rating. The M12 connector is available with both Isys 18mm and 26mm valve sizes for use with industry standard cables. Designed to fill a specific market niche, Isys valves are perfect for industrial markets with an automotive focus and OEMs standardized on M12 connectors. ISO standardization provides OEM security, especially for European-influenced global machine builders.

The new Isys M12 model is the latest addition to the Isys family of pneumatic valves, which use ISO 15407 and 5599 dimensional and electrical standards as its foundation.

IsysNet is the family's Fieldbus System for providing communication between the valve's pneumatic and electrical components. Utilizing a common platform compatible with all Isys ISO valves, IsysNet provides preferred connectivity with EtherNet/IP and Rockwell Automation's ControlNet.™ Parker's Isys eConfigurator is a 3D CAD manifold configuration system that reduces the time it takes to configure a manifold, with drawings and a bill of materials, by 80%.

Parker Hannifin
(269) 629-5000
clandis@parker.com
www.parker.com

New Remote Monitoring & Data Logging System

Onset Computer Corporation launched the HOBO Remote Monitoring System, a state-of-the-art industrial-grade data logging system that provides energy managers, facility managers and others with instant access to energy and HVAC/R systems data anywhere, anytime via the Internet. The new system combines data logging hardware with built-in GSM cellular communications and HOBOlink,™ a new web-enabled software platform. HOBOlink allows users to access current and historical data, set alarm notifications and relay activations, and manage and control HOBO Remote Monitoring systems right from their desktop.

The HOBO Remote Monitoring System provides fully integrated data logging and cellular communications in a single unit, eliminating the need for users to integrate components separately. And, the system features a plug-and-play architecture, which enables users to easily connect a range of Smart Sensors without programming, wiring or calibration. The system features a double weatherproof enclosure for applications where rooftop HVAC or other outdoor systems need to be monitored. Users have access to a wide selection of sensors for measuring a range of parameters including temperature, relative humidity, kW, kWh, AC voltage, AC amps, DC amps, gauge and differential pressure, CO_2 and more.

Onset Computer
(800) 564-4377
sales@onsetcomp.com
www.onsetcomp.com/rmsa

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 for this column was gathered on March 4, 2008.

Quincy, IL, February 7, 2008 — Gardner Denver, Inc. (NYSE: GDI) announced that revenues and net income for the three months ending December 31, 2007 were $510.3 million and $63.9 million, respectively. For the 12-month period of 2007, revenues and net income were $1.9 billion and $205.1 million, respectively. Diluted earnings per share ("DEPS") for the three months endeing December 31, 2007 were $1.18, 69% higher than the comparable period of 2006. For the 12-month period of 2007, DEPS were $3.80, 53% higher than the comparable period of the previous year. Results for the three-month period of 2007 included an approximately $8.4 million ($0.16 DEPS) reduction to the company's tax provision, primarily due to foreign tax credits. Other than the reduction in the tax provision, the company's DEPS improvement for the three months ending December 31, 2007 was primarily attributable to the incremental flow-through profitability of organic revenue growth, operational improvements, including benefits from cost reduction efforts, favorable changes in foreign currency exchange rates and lower interest expense.

Chairman's Comments Regarding Results

"Gardner Denver achieved a new level of performance in 2007, attaining record results for both revenues and earnings in the fourth quarter and full year. This accomplishment reflects the company's ongoing commitment to executing our core strategies and the unwavering dedication of our employees throughout the world," said Ross J. Centanni, Gardner Denver's Executive Chairman of the Board.

"As a result, our company has diversified into higher-growth end market segments and expanded our global presence. I remain cautious about the global repercussions of the current economic situation in the U.S. but believe that our diversification strategy will mitigate slowing growth in the industrial end market segment that is expected to occur in the United States in 2008."

"For the full-year 2007, compared to 2006, revenues increased 12%, reflecting the benefit of strong organic growth in Europe and Asia and the favorable impact of foreign currency exchange rates. For the fourth quarter of 2007, compared to the same period of 2006, revenues increased 16%," said Mr. Centanni. "We have realized accelerating organic revenue growth in the Compressor and Vacuum Products segment in each quarter of 2007. As we completed our manufacturing integration projects, production throughput improved, past due backlog declined and revenues grew."

"As a result of operational improvements and leveraging our costs, operating income grew nearly twice as fast as revenues in the fourth quarter of 2007, a 31% increase over the same period of 2006. For the full-year 2007, operating income grew 24% compared to 2006 or twice the rate of revenue growth for the year.

"Our Compressor and Vacuum Products segment revenues grew by 14% in the fourth quarter of 2007, compared to the same period of 2006. Orders increased 19% in the three months ending December 31, 2007 when compared with the same period of 2006, reflecting continued demand for engineered products and OEM applications on a global basis and low-pressure and vacuum applications in Europe. Order growth for this segment accelerated sequentially in the final two quarters of 2007, reflecting strong demand in end market segments, the benefit of reducing manufacturing lead times as we completed the integration of acquired operations and favorable changes in foreign currency exchange rates."

Mr. Centanni continued, "Compressor and Vacuum Products segment operating income[1] as a percentage of revenues expanded to 12.5% in the fourth quarter, the highest level achieved since 1998. The improvement is the result of the segment's strong flow-through profitability on organic revenue growth, cost reductions and the benefits of acquisition integration activities. Further improvement is expected to be realized in 2008, as I am pleased to report that during the fourth quarter we substantially completed the company's integration project in Schopfheim, Germany. This was the final significant integration project from Gardner Denver's 2005 acquisition of Thomas Industries. In 2008, these process improvements are expected to increase productivity while reducing lead times and inventory, generating annualized incremental operating earnings of approximately $6 million."

Mr. Centanni continued, "For the full-year 2007, we used cash provided by operating activities to repay $125.2 million of debt, reducing debt to total capital to 20%. In addition, in 2007 the company substantially completed the integration projects related to the Nash Elmo and Thomas Industries acquisitions. We feel we are well positioned to consider potential future strategic acquisitions."

Outlook

"Although we expect global economic growth to slow in 2008, we are still optimistic that orders for compressor and vacuum products will remain strong through the first half of 2008, driven by demand in Europe and Asia. Specifically, we expect to see strong demand for OEM applications and engineered products, as well as marine and European mobile applications. The rate of order growth in the second half of 2008 is expected to slow slightly, however, reflecting an anticipated downturn in the European economy's rate of growth. From a revenue perspective, we anticipate continued growth throughout 2008 as a result of the order outlook and a reduction in backlog due to the achievement of operational improvements. The Compressor and Vacuum Products segment ended 2007 with a record level of backlog, which should help drive results in 2008," said Mr. Centanni.

"Based on our current economic outlook, existing backlog and the expected benefit of operational improvements from completed integration projects, we are raising our full-year 2008 DEPS outlook range to $3.20 to $3.40, with first-quarter DEPS expected to be $0.75 to $0.80. This outlook includes the expected first-quarter shipment of the remaining contract for liquid natural gas and compressed natural gas loading arms destined for South America and some restructuring activities in Europe and Australia to further streamline operations and reduce administrative expenses. These restructuring activities are expected to reduce DEPS for the first quarter and full year by $0.02 and $0.04, respectively."

Mr. Centanni continued, "The company invested approximately $47.8 million in capital expenditures during 2007, compared to $41.1 million in 2006, due primarily to spending to complete acquisition integration projects. Depreciation and amortization expense was approximately $58.6 million in 2007, compared to $52.2 million in 2006. For the full-year 2008, capital spending is expected to be approximately $45 million to $50 million. The 2008 capital spending plan includes investments to expand the company's manufacturing capacity for compressor and vacuum products in China, which are expected to occur in the second half of the year."

Hamilton, Bermuda, February 14, 2008 — Ingersoll-Rand Company Limited (NYSE:IR), a leading diversified industrial firm, announced today that total revenues increased by 8% and pre-tax earnings from continuing operations increased by 16% in the fourth quarter of 2007, compared with the 2006 fourth quarter.

The company reported diluted earnings per share (EPS) of $9.06 ($2,518.5 million) for the fourth quarter of 2007. EPS from discontinued operations were $8.45 ($2,347.5 million). The earnings of discontinued operations include three components: a gain on the sale of the Bobcat, Utility Equipment and Attachments (Compact Equipment) businesses of $9.30 per share ($2,584.6 million); a charge of EPS -$1.00 (-$277.0 million), to increase the reserve for expected future asbestos costs; and EPS of $0.15 ($39.9 million), which represent the earnings and retained costs from discontinued businesses.

EPS from continuing operations of $0.61 ($171.0 million) were negatively impacted by $0.18 per share from a significantly higher effective tax rate of 38.4% in the quarter (see Taxes page 3).

Additionally, fourth-quarter earnings from continuing operations included EPS of approximately -$0.03 related to work force reductions throughout the company.

Reported net earnings per share totaled $0.72 ($222.0 million) for the fourth quarter of 2006, with EPS of $0.04 ($11.9 million) from discontinued operations and EPS from continuing operations of $0.68 ($210.1 million).

1 Segment operating margin

WALL STREET WATCH

"The fourth quarter of 2007 included several significant actions, which taken together will complete our portfolio transformation," said Herbert L. Henkel, chairman, president and chief executive officer. "In the fourth quarter, we generated solid revenue growth, demonstrating operational focus and discipline while executing a significant portfolio change."

Additional Highlights for the 2007 Fourth Quarter

Revenues: The company's revenues increased by approximately 8% to $2,323 million, compared with revenues of $2,143 million for the 2006 fourth quarter. Approximately 4 percentage points of the revenue increase was attributable to currency. Recurring revenues, which are comprised of parts, service, rental and used equipment, increased by 11% compared with the fourth quarter of 2006 and accounted for 18% of total revenues.

Operating Income and Margin: Operating income of $298.8 million for the fourth quarter of 2007 increased by 7%, compared with $279.1 million for the fourth quarter of 2006, as higher volumes, improved pricing and productivity gains were offset by year-over-year material inflation, restructuring costs and unfavorable product mix. Fourth-quarter 2007 operating margin was 12.9% compared with 13% in 2006. Excluding restructuring costs, fourth-quarter 2007 operating margin was 13.4%.

Interest and Other Income/Expense: Interest expense was $36.4 million for the 2007 fourth quarter compared with $36.0 million in the 2006 fourth quarter. Other income totaled $15.0 million for the fourth quarter, compared with $4.9 million in other expense for the fourth quarter of 2006. The year-over-year difference is primarily related to higher interest income from increased cash balances from the sale of businesses and lower foreign exchange losses and minority interest charges in 2007 compared with the fourth quarter of 2006.

Full-Year 2007 Results

Full-year 2007 net revenues were $8,763 million, a 9% increase compared with net revenues of $8,034 million in 2006. Excluding acquisitions and currency, revenues increased by 6%. Operating income for 2007 totaled $1,057.8 million compared with $998.5 million in 2006. Operating margin for 2007 was 12.1%, compared with 12.4% in the prior year. Higher revenues and productivity improvements were partially offset by cost inflation, unfavorable product mix and restructuring costs. Excluding restructuring costs, the 2007 operating margin was 12.4%, equal to 2006.

The company reported full-year 2007 EPS of $13.43 ($3,966.7 million). Earnings per share from discontinued operations were $10.95 ($3,233.6 million). Discontinued operations include gains on the sale of discontinued construction machinery businesses equal to EPS of $11.04, a charge of -$0.94 per share related to increasing asbestos reserves for the fourth quarter and earnings equal to approximately $0.85 per share from the earnings and retained costs from discontinued businesses. EPS from continuing operations were $2.48 ($733.1 million). Full-year results also include restructuring costs equal to EPS of -$0.06.

The company reported 2006 EPS of $3.20 ($1,032.5 million), including EPS of $0.83 ($267.5 million) from discontinued operations and EPS of $2.37 ($765.0 million) from continuing operations.

The company continued to be a strong cash generator with full-year available cash flow in 2007 of $714 million. Full-year available cash flow also includes a $217 million tax payment.

The company classifies its businesses into three reportable segments based on industry and market focus: Climate Control Technologies, Industrial Technologies and Security Technologies.

Industrial Technologies is focused on providing solutions to enhance customers' industrial and energy efficiency and provides equipment and services for compressed air systems, tools, fluid power production and energy generation systems. This segment includes Club Car® golf cars and utility vehicles. Total revenues in the fourth quarter increased by approximately 10% to $758 million.

Air Solutions revenues increased by 12% with improved activity in industrial and process markets for complete air compressor units and increased revenues from the aftermarket business. Productivity Solutions revenues increased by 6%, as expanding activity in material handling and industrial markets outside North America offset sluggish domestic markets, particularly for tools.

Club Car® revenues increased by 7% compared with the fourth quarter of 2006, primarily reflecting increased parts and rental revenues, higher sales of utility and off-road vehicles and market share gains in a soft golf market.

The fourth-quarter operating margin for Industrial Technologies of 12.9%, compared with 13.7% last year, reflected higher volumes, improved pricing and productivity savings, which were more than offset by material inflation, restructuring and the cost of growth investments.

2008 Outlook

"Ingersoll Rand had a solid close to the year and has continuing momentum as it enters 2008. Many of Ingersoll Rand's major end markets continued to experience solid demand as we closed out 2007, and orders increased by about 7% compared with last year. Our backlog at year end increased in all of our business segments and was up by more than 20% overall compared with year-end 2006," said Henkel. "Based on our recent order pattern and a review of customer and channel activity, we expect moderate growth in 2008. We expect slow growth in North America and Western Europe and continued brisk growth in the developing economies of Eastern Europe, Asia and Latin America. Consistent with this environment, we anticipate revenue growth of approximately 6% to 7% for 2008, with 2% related to currency. Operating margins are expected to increase by 1 to 1.5 percentage points in 2008 based on higher volumes, improved cost productivity and a somewhat lower level of material cost inflation relative to the past few years."

"Based on a projected May 31 closing date, Ingersoll-Rand's full-year 2008 earnings from continuing operations are forecasted to be $3.80 to $3.90 per share, with discontinued operations at $0.06 per share of cost. It is anticipated that the Trane acquisition will require a number of one-time charges, primarily inventory step up, currently estimated at $0.40 to $0.45 per share. These charges are not reflected in our full-year forecast. This full-year forecast reflects a tax rate of 22–23% for continuing operations and an average diluted share count of 312 million shares. Available cash flow in 2008 is anticipated to exceed $1.1 billion."

"We expect end market activity and material costs in the first quarter of 2008 to be consistent with the fourth quarter of 2007. As a result, we expect Ingersoll Rand's first-quarter 2008 revenue growth of 6–7% compared with 2007 and earnings from continuing operations in a range of $0.72 to $0.77 per share," said Henkel.

MARCH 4, 2008 PRICE PERFORMANCE	SYMBOL	LAST PRICE	1 MONTH	6 MONTHS	12 MONTHS
Parker-Hannifin	PH	$64.38	-6.0%	-9.6%	17.7%
Ingersoll Rand	IR	$42.08	8.8%	-17.9%	0.1%
Gardner Denver	GDI	$37.98	15.7%	-2.3%	17.3%
United Technologies	UTX	$68.90	-6.4%	-7.0%	7.8%
Donaldson	DCI	$41.61	-2.0%	11.0%	20.8%
EnPro Industries	NPO	$30.33	-4.7%	-27.9%	-18.4%
SPX Corp	SPW	$104.71	0.1%	15.9%	52.8%

JOB MARKET

Job Openings in the Compressed Air Industry

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