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March 2007

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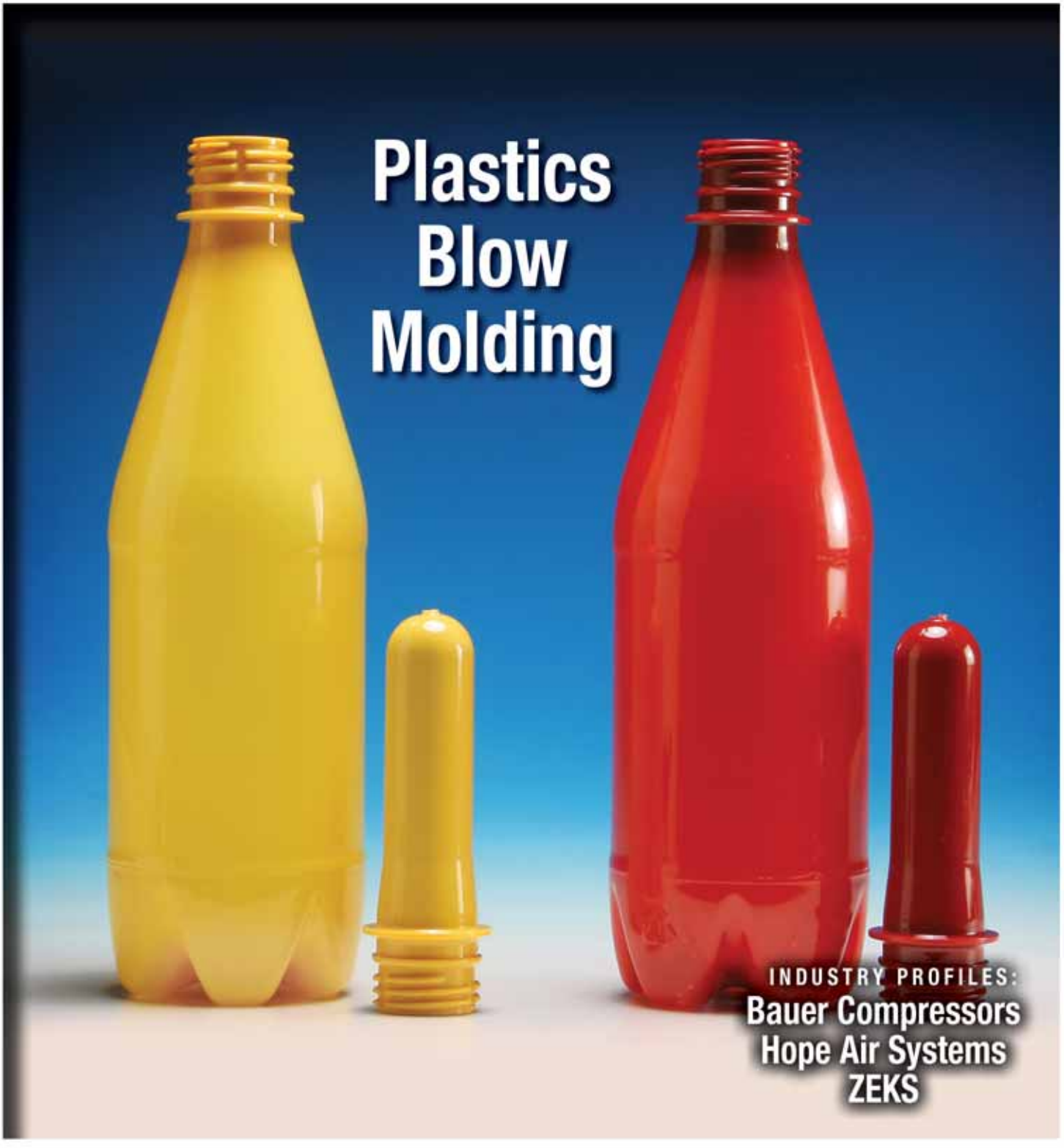

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FROM THE EDITOR

High-Pressure Opportunities

High-pressure air, for most compressed air industry professionals, represents any application, above roughly 300 psig. The majority of standard industrial, flat-top roof, plant-air applications run at "medium" pressures between 75–150 psig or at "low" pressures between 7–40 psig. High-pressure air, between 300–7,000 psig, is used in many applications and provides opportunities in many industrial processes, including blow molding.

Opportunities exist, for energy savings, at PET stretch blow molding facilities. In this edition, **Mr. Peter Rhoten**, provides an interesting account of how separating the pressure requirements, at a PET facility, creates energy savings. The facility needed three pressures of compressed air (110 psig, 500 psig and 620 psig). Most of the lower pressures were supplied by regulating down the high-pressure air. Creating dedicated piping loops and supply sources, for the different pressures, provided the facility with energy saving opportunities.

Injection and extrusion blow molders, may have opportunities to improve the efficiencies of the air nozzles used in open-blowing processes. Air nozzles are one of the first things examined in a blow molder's air system. **Mr. Hank Van Ormer** provides an analysis of nozzles, in this edition, which are capable of amplifying the volume of compressed air. This amplification of volume reduces the amount of compressed air needed, for the blowing application, in the blow molding system.

Industry has many applications, which are satisfied by high-pressure compressed air. **Bauer Compressors**, a world-wide leader in high pressure compressors, shares some of the many applications they serve, in the pages of this edition. The applications, to name a few, range from leak detection, instrument calibration, relief valve testing, seismographic exploration, and even pneumatic rams designed to test seat belts. High-pressure compressed air, at pressures between 300–7,000 psig, make these processes possible.

As a person who has done most of my work at medium-pressures, I find the high-pressure opportunities, for energy-savings and for innovative applications, very interesting. I hope you do as well.

ROD SMITH

> "Compressed air, at 300–7000 psig, has many industrial applications."

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www.airbestpractices.com

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

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

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Wall Street Watch

BY COMPRESSED AIR BEST PRACTICES

The intent of this column is to provide industry watchers with publicly held information on NYSE-traded companies, involved with the sub-industry of compressed air. It is not our intent to provide any opinions or recommendations related to stock valuations. All information gathered in this column was as of market close February 5, 2007.

A Strong January

SPX Corporation, Ingersoll Rand and **Parker Hannifin** had a strong January with stock price increases of 10–16%. **United Technologies** also posted a strong month and all four stock prices closed near their 52-week highs. The entire industrial machinery sub-industry saw a very strong January, in terms of price performance.

WALL STREET WATCH

BY COMPRESSED AIR BEST PRACTICES

SPX Corporation

SPX Corporation (NYSE:SPW) announced its 2007 annual financial guidance:

- Revenues are expected to increase between 9% and 11% to approximately $4.7 billion. Organic revenue growth is expected to be 6% to 8%, while completed acquisitions and the impact of currency fluctuations are expected to increase reported revenues by approximately 3%.
- Earnings from continuing operations are expected to increase to $3.80 to $3.95 per share, up 26% to 31% from the company's 2006 full-year target. The primary drivers of this improvement are continued strength across the company's segments and a reduced tax rate.
- Free cash flow from continuing operations (cash flow from continuing operations less capital expenditures) is expected to increase to $240 million to $280 million. This performance represents 100% to 120% conversion of expected net income.

Chris Kearney, President and CEO said, "We are pleased to announce our expectations for 2007, including double-digit revenue, earnings and free cash flow growth. These improvements are driven by our continued focus on improving SPX organically and through strategic acquisitions."

Mr. Kearney continued, "Our internal initiatives focus on revenue growth through innovation, new product development and expansion in emerging markets. Our focus on improved operating performance is centered on expanding our lean culture and processes, and managing a well-coordinated global supply chain process. This continuous improvement mindset is allowing SPX to better serve our growing global customer base. In addition, global demand in our key end markets remains generally strong. SPX's strategic focus on providing solutions into global infrastructure development, particularly power and energy, is expected to continue to drive growth in 2007 and beyond," Mr. Kearney concluded.

FEB. 5, 2007 PRICE PERFORMANCE	SYMBOL	LAST PRICE	PRICE CHANGE YTD	1 MONTH	6 MONTHS	12 MONTHS	52-WEEK HIGH	52-WEEK LOW	BETA
Parker Hannifin	PH	$85.37	11.0%	11.4%	14.6%	11.8%	$88.00	$69.70	1.17
Ingersoll Rand	IR	$43.38	10.9%	10.1%	14.2%	9.6%	$49.00	$34.95	1.39
Gardner Denver	GDI	$38.21	2.4%	6.7%	5.2%	36.2%	$40.73	$27.28	0.93
United Technologies	UTX	$67.77	8.4%	8.1%	8.3%	18.5%	$68.75	$56.20	0.70
Donaldson	DCI	$35.30	1.7%	3.0%	7.5%	3.6%	$38.97	$30.16	0.92
Enpro Industries	NPO	$33.15	-0.2%	3.6%	7.0%	10.0%	$40.08	$27.84	1.97
SPX Corp.	SPW	$70.75	15.7%	16.0%	28.5%	50.4%	$71.00	$46.47	1.12
Industrials Sector				3.7%	13.4%	14.8%			
Ind. Machinery Sub-Ind				7.5%	12.6%	16.2%			

Ingersoll Rand

Ingersoll Rand Company Limited (NYSE:IR), announced that revenues increased in the fourth quarter of 2006, compared with the 2005 fourth quarter.

- Revenues increased by 7% to $2,891 million in the 2006 fourth quarter. Record high full-year 2006 revenues increased by 8% to $11.4 billion.
- Diluted earnings per share (EPS) from continuing operations for the 2006 fourth quarter were $0.74. Record high full-year EPS from continuing operations increased by 10% to $3.39, excluding the third quarter tax reserve charge of $0.08 per share.
- Full-year 2006 available cash flow was $762 million.
- Full-year 2007 forecast EPS range of $3.50 to $3.60 and available cash flow of $900 million.

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

Industrial Technologies provides solutions to enhance customers' industrial and energy efficiency and provides equipment and services for compressed air systems, tools, fluid handling and energy generation systems. Total revenues in the fourth quarter increased by approximately 15% to $541.1 million. Fourth-quarter operating margins were 14.4% compared with 12.2% in 2005. The strong revenue gain primarily reflects higher worldwide sales of complete units of air compressors and increased revenues from the aftermarket business. Operating margin improvement was due to higher volumes, pricing gains and improved productivity.

The company reported net earnings of $222.0 million, or EPS of $0.72, for the fourth quarter of 2006. Fourth-quarter earnings included approximately $8 million of costs, or EPS of $(0.02), related to work force reductions throughout the company. Net earnings for the 2005 fourth quarter of $291.6 million, or EPS of $0.87, included $272.9 million, or EPS of $0.81, from continuing operations, as well as earnings of $18.7 million, or EPS of $0.06, from discontinued operations. "Our fourth quarter performance demonstrated the strength of our diversified business portfolio," said **Herbert L. Henkel**, Chairman, President and Chief Executive Officer. "Double-digit revenue increases in our diversified industrial businesses more than offset revenue declines in businesses affected by the significant slowdown in North American residential markets."

WALL STREET WATCH

BY COMPRESSED AIR BEST PRACTICES

"The corrective actions we initiated in the fourth quarter to reduce costs and, where warranted, to adjust operations consistent with market conditions will deliver benefits throughout 2007."

"Overall, 2006 represented the first significant challenge for the current diversified Ingersoll Rand business portfolio. Our record full-year revenues and earnings per share provide clear evidence that our strategy is working, and that our business execution remains solid." The company continued to be a strong cash generator with full-year available cash flow in 2006 of $762 million.

"Based on the forecasted macro-economic environment, we anticipate revenue growth of approximately 4% to 5% for 2007. We also expect to supplement our revenue growth with new bolt-on acquisitions. Operating margins are expected to be consistent with 2006 as higher volumes and ongoing productivity actions offset material cost inflation and investments to drive dramatic growth and operational excellence.

"Available cash flow in 2007 is anticipated to exceed $900 million. We expect to pursue internal investments that drive global organic growth, bolt-on acquisitions, stock buybacks and dividend enhancements from the cash flow generated in 2007. We expect to invest approximately one billion dollars between share buybacks and acquisitions in 2007," said Henkel. "We expect end markets and material costs in the first quarter of 2007 to be consistent with the fourth quarter 2006. We anticipate continuing weak residential construction markets in the first quarter, followed by a slow, gradual recovery for the balance of 2007."

FEB. 5, 2007 COMPANY PERFORMANCE	SYMBOL GROWTH	5-YR REVENUE GROWTH	1-YR EPS GROWTH	5-YR EPS EQUITY	RETURN ON MARGIN	1-YR PROFIT
Parker Hannifin	PH	9.4%	47.6%	12.3%	19.4%	7.7%
Ingersoll Rand	IR	6.0%	28.9%	43.7%	NA	8.0%
Gardner Denver	GDI	26.2%	30.9%	17.8%	16.9%	7.8%
United Technologies	UTX	11.4%	18.6%	14.1%	21.8%	7.3%
Donaldson	DCI	8.3%	13.8%	13.4%	25.1%	8.1%
Enpro Industries	NPO	5.1%	N/A	8.7%	5.9%	-1.9%
SPX Corp.	SPW	9.9%	N/A	N/A	5.4%	4.0%

Parker Hannifin

Parker Hannifin Corporation (NYSE: PH), reported second quarter fiscal year 2007 results. The company set new second quarter records for sales and income from continuing operations, both of which increased by double-digit percentages from a year ago.

Sales for the second quarter of fiscal-year 2007 were $2.5 billion, up 16.4 percent, as compared to sales of $2.2 billion from the same period last year. Income from continuing operations in the second quarter of fiscal 2007 was $1.64 per diluted share, an increase of 53.3 percent over the $1.07 per diluted share posted in the same period a year ago.

"Led by exceptional performance in our Industrial International and Aerospace segments, we were able to deliver another record second quarter, and we remain solidly on track for another outstanding year in fiscal 2007," said Chairman, CEO and President **Don Washkewicz.** "The record results we are delivering, quarter after quarter, are being driven by our employees' ongoing execution of our Win Strategy."

Total operating margin across all segments in the second quarter was 13.2 percent versus 11.8 percent in the same period a year ago.

- In the North American Industrial segment, second quarter operating income increased 2.8 percent over the prior year to $133.9 million, on sales of $959.7 million.
- In the International Industrial segment, second quarter operating income increased 78.9 percent over the prior year to $121.8 million, on sales of $922.0 million.
- In the Aerospace segment, second quarter operating income increased 43.2 percent over the prior year to $67.8 million, on sales of $402.0 million.
- In the Climate & Industrial Controls segment, second quarter operating income decreased 29.8 percent over the prior year to $7.0 million, on sales of $227.4 million.

"Our 16.4 percent sales growth in the quarter significantly exceeded our growth goal of 10 percent," said Washkewicz. "The growth was profitable and balanced, with 6.4 percent derived organically, 6.4 percent via acquisitions and 3.6 percent from the favorable impact of foreign currency."

"While we are very pleased with our overall results this quarter, special mention must be made of our International Industrial and Aerospace segments," continued Washkewicz. "In the International segment, sales grew by 36 percent and operating income increased by nearly 80 percent. Our Aerospace business also delivered excellent results this quarter. Revenues grew by 16 percent and operating income by 43 percent. We expect continued strength in this segment of our business."

"This is especially good news as International Industrial and Aerospace now represent more than half of our total revenues," said Washkewicz. "Particularly diligent execution of the Win Strategy in Europe is enabling us to achieve margins comparable to our North American business."

FEB. 5, 2007 VALUATION RATIOS	SYMBOL	PRICE/ EARNINGS RATIO	PRICE/ EARNINGS GROWTH RATIO	PRICE/ BOOK RATIO	PRICE/ SALES RATIO	DIVIDEND YIELD
Parker-Hannifin	PH	13.24	1.05	2.29	0.98	1.2%
Ingersoll Rand	IR	13.56	1.05	NA	1.15	1.6%
Gardner Denver	GDI	16.76	1.00	2.52	1.21	NA
United Technologies	UTX	18.27	1.40	3.93	1.33	1.6%
Donaldson	DCI	21.93	1.64	4.88	1.59	1.0%
Enpro Industries	NPO	22.10	1.49	1.21	0.76	NA
SPX Corp.	SPW	28.41	1.64	2.11	0.96	1.4%

United Technologies

United Technologies Corp. (NYSE:UTX) reported fourth quarter 2006 earnings per share of $0.87 and net income of $865 million, up 23 percent and 20 percent respectively. Consolidated revenues for the quarter increased 14 percent to $12.8 billion, including organic growth of 10 percent.

Full-year earnings per share of $3.71 and net income of $3.7 billion were 19 and 18 percent higher, respectively, than 2005 results. Revenues increased 12 percent to $47.8 billion, including 9 points of organic growth, 2 points of acquisitions and 1 point of foreign exchange.

Cash flow from operations after capital expenditures exceeded net income for both the quarter and full year. In the fourth quarter, cash flow from operations was $1.66 billion and capital expenditures were $351 million. For the full year, cash flow from operations was $4.80 billion and capital expenditures were $954 million. Voluntary cash contributions to pension plans were $159 million in the fourth quarter and $190 million for the year.

"UTC had another solid year in 2006 and is set for more of the same in 2007," said UTC Chairman and Chief Executive Officer **George David**.

"Organic growth for the year was strong at 9 percent and follows 7 percent in 2005 and 8 percent in 2004. These growth rates reflect UTC's innovative and competitive products, strong presence in emerging markets, and good conditions in most of our markets worldwide. The exception has been Carrier's North American residential market over the second half of 2006 on a substantially weaker U.S. housing market. However, robust aerospace and commercial construction markets well more than offset this."

"UTC also experienced production challenges in 2006 at Carrier with the launch of its high efficiency residential air conditioning product and at Sikorsky on a doubling of volume over the 2004–2007 period. UTC's 19 percent growth in earnings per share for the year given these market and production challenges demonstrates the balance in the portfolio and the strength of UTC's businesses overall. We believe we are well positioned for earnings increases in 2007 and especially on favorable compares at Carrier and Sikorsky. We confirm prior guidance for 2007 earnings per share in the $4.05 to $4.20 range and cash flow after capital expenditures again to exceed net income," David added.

Share repurchase in the quarter was $738 million and brought the year's total to $2.07 billion. Acquisition spending, including debt assumed, was $1.0 billion for the year with approximately $514 million in the fourth quarter. Debt to capital ended the year at 31 percent.

EXPANDING PRODUCTION AT A PET

BY PETER RHOTEN

This report is a summary of a compressed air system investigation our firm conducted at a PET packaging facility in the U.S. This PET packaging facility wanted to expand production without installing new high-pressure air compressors. Our investigation showed the facility how to make this happen, with an ROI of 1.5 years. The first goal of the investigation was to provide a situation analysis of the demand side (the blow molding machines) and of the supply-side (the high pressure and low pressure) compressed air system. The second goal was to recommend an action plan, complete with capital cost, energy cost and return-on-investment analysis.

> "The use of regulators introduces a 30% loss due to valve inefficiencies."

All values and prices in this report were estimates based on observations made in the plant and on our experience with PET facilities and with general compressed air use. We were not requested to do an "audit," entailing a more exact study utilizing flow and kW metering technology. This would have provided exact information of actual compressor capacities and blow molder consumption.

Situation Analysis Part I — The Blow Molding Machines

The PET packaging facility currently has 16 blow molders in production. There are 10 Aoki and 6 Sidel units. There are plans to add at least one Aoki and a Mag, plus a possible two additional Aoki and two Sidels units. Each molder has a dedicated drop from the low-pressure and/or high-pressure headers.

The 12 Aoki blow molders see large pressure swings on the blow pressure. The machines that have gauges see swings of as much as 200–300 psi. The process engineer reported that the Aokis required 500 psi, on average, to blow the wide-mouth bottles. In addition, the high-pressure air is reduced to 150 psi, for moving the molds. Our experience is that 30 kg (440 psi) is usually sufficient for blowing wide-mouth bottles. The 150 psi use may lead to higher-than-expected pressure drops during the blow cycle. Also, the regulators may restrict flow, also leading to the excessive pressure drops.

Of the six Sidel blow molders, four use regulators to provide the operation air and two use plant air at 110 psi and a regulator, for an additional 120+ psi use. The Sidel machines all see very small pressure swings, as their blow cycles are shorter and more frequent.

PACKAGING PLANT

Due to the plant product mix, there are numerous mold changes that lead to 1–3 molders being down for mold change at any time. However, in the last few months, the facility has had occasions, when all molders are running. During this period, the six high-pressure compressors could not keep up with demand on a consistent basis.

This also coincided with the preventative maintenance (PM) cycle. All six Belliss compressors go through an annual full PM and a third-stage PM every six months. The six-month PM coincides with the plant high demand period, all molders being up, and with hot weather.

There have been occasions where the low-pressure system has been out of air. This appears to also have coincided with peak plant demand and hot weather. For the high-pressure system, the number one complaint has been a lack of pressure under full load.

There were no reports of air quality issues (water or oil in the lines).

There is a planned addition of one Aoki and one Mag in the next couple of months, and a possibility of two more Aokis and Sidels at a later date. Further expansion is possible.

Table 1: Existing Blow Molders and Working Pressures (psi)

MOLDER	BOTTLE	OPERATION AIR (PSI)	BLOW AIR (PSI)	CURRENT BPH[6]
#1 Aoki	18 oz	110 plant air[3]	610 regulated	1,903
#2 Aoki	18 oz	110 plant air[3]	440 regulated	1,945
#3 Aoki	12 oz	110 plant air[3]	500 regulated	2,192
#5 Aoki	28 oz	110 plant air[3]	Regulated[2]	1,130
#7 Aoki	18 oz	110 plant air[3]	610 unregulated	2,009
#8 Aoki	40 oz	110 plant air[3]	600 regulated	1,080
#9 Aoki	18 oz	110 plant air[3]	520 regulated	2,182
#10 Aoki	18 oz	110 plant air[3]	500 regulated	2,182
#11 Aoki	32 oz	110 plant air[3]	Regulated[1]	2,009
#12 Aoki	40 oz	110 regulated[5]	Regulated[2]	1.054
#1 Sidel SBO-4	1.75 liter	110 plant + reg[4]	Unregulated[1]	1,600
#2 Sidel SBO-6	1.75 liter	120 regulated[4]	595 unregulated	2,400
#3 Sidel SBO-4/6	750 ml	Regulated[1]	Unregulated[1]	5,600
#4 Sidel SBO-2	45 oz	Regulated[1]	Unregulated[1]	2,400
#5 Sidel SBO-2	1.75 l	110 plant + reg[4]	Unregulated[1]	1,600
#6 Sidel SBO-6	375 ml	Regulated[1]	610 unregulated	

The above pressure data was taken at 1:30 PM on 9/16.
[1] This machine did not have any gauges on the inlet or regulator
[2] This machine was down for mold change
[3] Each Aoki has an internal regulator to reduce 500 psi to 150 psi for moving the block
[4] Some of the Sidel machines use a regulator to give 120+ psi air
[5] This machine uses a regulator for operation air
[6] Bottles per Hour

EXPANDING PRODUCTION AT A PET PACKAGING PLANT

High-Pressure Compressor Room at PET Facility

Situation Analysis Part II — The High Pressure System

Observations

Each high-pressure compressor is a fully packaged system, with the receiver and refrigerated dryer mounted on the same skid as the compressor. All refrigerated dryers are water-cooled. A local panel controls each compressor, with the load signal taken from the respective skid-mounted receiver.

Each compressor is taking its inlet air from a roof-mounted filter/silencer. The inlet ducts are sized the same as the inlet flange on the compressor. The inlet ducts are straight runs except for #3 and #6, which have 2 x 45° elbows. There was no noticeable heating or pulsing of the duct work. Using outside air may affect compressor capacity on extremely hot, humid days (over 90 °F and 70% RH). The compressor room is reasonable ventilated, as the room was at a tolerable temperature on an 80 °F, sunny day, with only a standard sized compressor-room door open. There are a series of ventilated louvers to remove heat. All equipment in the room is water-cooled, which helps prevent heat buildup in the room. Compressor 6 is located in a separate room that is well ventilated and also contains resin dryers. Other equipment in the main compressor room includes some switch gear, chillers and the low-pressure compressor system.

The compressor load conditions were observed over several different points during the three days. Maintenance reported that the operating conditions were normal in the plant. This plant is a little unique in that it has a large product mix, meaning that there are typically 1–3 molders down each day for mold changeover. The plant manager commented that due to the product mix, plant efficiency is 60–65% and improving.

Compressors 2, 3, 4 and 6 did not unload under the "normal load conditions" seen during the visit. Maintenance reported that it is very unusual for any of those compressors to unload, unless the Husky injection machines are off-line or multiple molders are not in production. Compressors 1 and 5 do unload, but do so erratically.

On Wednesday afternoon, a condition was observed where all 6 Sidel molders were not in production and only 8 of the 10 Aokis were in production. During this period, compressors 3 and 4 were fully loaded and compressor 2 was partially loaded. During the time that the Sidels were out of production, compressors 1, 5 and 6 were fully unloaded.

The plant piping system starts with compressors 1–5 connecting to a 6" header. The header forms a nice loop throughout the molding area of the plant and uses a minimum of bends and no reducers. The pressure at each molder was in a narrow range of 600–610 psi. Compressor 6 joins the loop near the start of the Aoki molders via a 3" or 4" pipe over a run of approximately 250 feet. There are two crossover pressure reducers in the system.

On the discharge of compressor 1 is a reducer that crosses over to the low-pressure (110 psi) system. This line is normally off and only turned on if needed during low-pressure maintenance. There appears to be a possible piping issue in this line. The reducer joins the main low-pressure loop after the low-pressure receiver and near the ceiling of the compressor

room. With the piping arranged as it is, condensate from the system can gather in this pipe and there is no automatic drain in the run. Maintenance has reported a water issue in the low-pressure system, when this line is used — indicating that condensate does gather in the run. It may be better to take this run into the low-pressure receiver to avoid condensate buildup in the pipe run. Off of compressor 6 is a reducer to 150 psi dedicated to the Husky injection machines. There have been no problems reported with this line.

There is a lack of usable compressed air storage in the system. Each compressor has a local 240-gallon tank providing 1,440 gallons of storage. However, being divided before the header, the storage has little impact on enabling the compressors to unload. The header and loop provide a nice pressure balance in the system, but additional storage in or near the compressor room would allow the compressors to unload and rotate, using the existing sequencing panel. A general rule for adequate storage is 1 gallon per cfm of capacity. This would mean the system should have about 5,000 gallons of storage. Adequate storage would enable the compressors to unload. Proper unloading and rotating of the compressors reduces wear, leading to reduced maintenance costs.

There is a central sequencing control system, but it is not being used. The sequencing panel was used at one time, but during extended unloaded time, the compressors would shut down. When demand increased, the compressors would take too long to ramp up and the system pressure would drop low enough to shut down molders on alarm. If the sequence panel is to be used, there must be adequate central storage and the compressor panels modified to enable a longer unloaded run time before shut down, or to not shut down at all.

Compressor 6 feeds a dedicated 150 psi line to the Husky equipment via a pressure reducer. Compressor 6 rarely unloads. Maintenance reported that compressor 6 does tend to unload when the Huskies are out of production. As noted, only compressors 1 and 5 see any consistent unloading. Compressors 1–5 are in line in the compressor room such that compressor 1 is near the Sidel end of the loop and compressor 5 is near the Aoki end of the loop. As pressure builds in the system, compressors 1 and 5 see the rise first and unload. Actual settings on the pressure switches may also affect which compressors unload in which sequence.

During full plant production, there is no high-pressure compressor back-up capacity. All six compressors are required to meet demand. During July and August, the plant had to shut down various molders because the compressors could not keep up during full production due to the hot days and the machines being near the end of their PM cycle.

EXPANDING PRODUCTION AT A PET PACKAGING PLANT

Table 2: The High-Pressure Compressor System

COMPRESSOR:	WH28H3N (#1)	WH28H3N (#2)	WH28H3N (#3)
Make:	Belliss & Morcom	Belliss & Morcom	Belliss & Morcom
Motor Horsepower:	300	300	300
Motor RPM:	1,175 (belt)	1,175 (belt)	1,175 (belt)
Motor FLA:	361	361	361
Capacity:	730 cfm at 650 psi	730 cfm at 650 psi	730 cfm at 650 psi
Compressor hours:	150,465	133,308	75,223
Loaded hours:	Unreliable	Unreliable	Unreliable
Condition:	Good	Good	Good
Coolers:	Good, running cool	Good, A/C a bit warm	Good, running cool
Receiver:	240 gal (on skid)	240 gal (on skid)	240 gal (on skid)
Dryer:	Hankison 80500	Hankison 80500	Hankison HPRD-3
Dryer condition:	Good	Good	Good
Drains:	Timed-electric, central control	Timed-electric, central control	Timed-electric, central control
COMPRESSOR:	**WH40H3N (#4)**	**WH28H3N (#5)**	**WH40H3N (#6)**
Make:	Belliss & Morcom	Belliss & Morcom	Belliss & Morcom
Motor Horsepower:	500	300	500
Motor RPM:	1,175 (belt)	1,175 (belt)	1,175 (belt)
Motor FLA:	567	361	569
Capacity:	1,100 cfm at 650 psi	730 cfm at 650 psi	1,100 cfm at 650 psi
Compressor hours:	75,309	38,077	72,319
Loaded hours:	Unreliable	Unreliable	Unreliable
Condition:	Good	Good	Good
Coolers:	Good, running cool	Good, running cool	Good, running cool
Receiver:	240 gal (on skid)	240 gal (on skid)	240 gal (on skid)
Dryer:	Hankison HPRD-4	Zurn R-150W-7.5	Hankison HPRD-4
Dryer condition:	Good	Good	Good
Drains:	Timed-electric, central control	Timed-electric, central control	Timed-electric, central control

High-Pressure System Conclusions

The high-pressure system does its job as long as all the molders are not running at full production. But system is used inefficiently and is insufficient during peak production. The only high-pressure requirements are from the molders. However, the heavy use of regulated air for Aoki mold movements, Sidel operation and Husky operation create a heavy load on the system.

The use of regulators introduces a 30% loss due to valve inefficiencies. This means that regulating 414 cfm of air from 600 psi to 500 psi, creates an additional load of 124 cfm on the high-pressure compressors. The use at 150 psi on the Aokis is double reduced — it is reduced to 500 psi at the machine, then further reduced to 150 psi inside the machines. This means that 1,504 cfm is reduced to 500 psi, creating a demand of 451 cfm, then further reduced to 150 psi with another 30% loss creating an additional 135 cfm of demand.

The Sidels and Mag will use about 210 cfm total of 600 psi air regulated to 150 psi resulting in a further demand of 63 cfm. The Husky machines also use 150 psi regulated from 600 psi. This use for the Cool Jets is estimated at 200 cfm, with an additional 60 cfm in valve losses.

Table 3: Demand for High-Pressure Air by the Blow Molders

1,401	cfm	600 psi — Sidel blow use
414	cfm	500 psi — Aoki blow use
124	cfm	Aoki 500 psi reducing losses
1,504	cfm	Aoki 150 psi use
451	cfm	Aoki reducing 600 psi to 500 psi
135	cfm	Aoki reducing 500 psi to 150 psi
210	cfm	Sidel/Mag 120 psi — 150 psi use
63	cfm	Sidel/Mag reducing 600 psi to 120 psi–150 psi
200	cfm	Husky 150 psi use
60	cfm	Husky reducing 600 psi to 150 psi
4,562	cfm	Total demand on the high-pressure compressors

Table 4: The Supply of High-Pressure Air

730	cfm	Belliss #1 — WH28H3N
730	cfm	Belliss #2 — WH28H3N
730	cfm	Belliss #3 — WH28H3N
1,100	cfm	Belliss #4 — WH40H3N
730	cfm	Belliss #5 — WH28H3N
1,100	cfm	Belliss #6 — WH40H3N
5,120	cfm	Total high-pressure capacity

This results in the high pressure system, with all molders in production, being 89% loaded (4,562 scfm/5,120 scfm). With a 15% reduction in compressor capacity, due to normal wear and high ambient temperatures, the compressor system is fully-loaded, or not quite up to capacity, even if the new molders are excluded.

Improper sequencing of the Belliss & Morcom compressors also leads to inefficiency as there is uneven wear across the compressors. Introducing proper storage and sequencing can reduce wear and operating costs, by reducing pressure at the compressors.

Any addition beyond the planned expansion is not possible with the current system.

This analysis does not take into account any air leaks or pressure drops through filters, valves or other devices. Also, there is air loss through the electric drain traps on the compressors. The electric drain traps, will be replaced by zero air-loss traps.

(Continued on page 44)

Central Cooling System

for New PET Air Compressors

BY GRAHAM WHITMORE

The Pepsi bottling plant in Harrisburg, PA was expanded in 2006, with the addition of a new PET bottling line for Pepsi's Aquafina bottled water.

The entire automated production line includes the PET bottle-molding facility and water filtration plant, water-cooled air compressors and a water-cooled atmospheric dehumidification plant. Atmospheric dehumidification is especially important in PET production to avoid condensation on the (chilled water-cooled) molds, during the summer production when humidity is high.

The primary air compressor is a water-cooled, oil-free, rotary machine, followed by a desiccant dryer, which supplies oil-free air with a dew point around -20 ºF. This is immediately followed by an oil-free, horizontally opposed, piston booster compressor, which supplies 600 psig air pressure to the PET blow molder.

Motivair supplied the central, closed-loop, fluid-cooling system for both of the water-cooled air compressors, the PET water-cooled chiller and the water-cooled atmospheric dehumidification plant. The total cooling load was approximately 2.3 million BTU/h and required a continuous, reliable flow of clean water/glycol at 85 ºF for the plant to remain in operation 24 hours per day. Harrisburg design temperatures range from 7 ºF in winter to 94 ºF in summer, with a maximum wet-bulb temperature of 77 ºF.

> "There is no performance advantage achieved by over-cooling the fluid in winter."

A closed-loop, evaporative-cooling tower was selected for the cooling duty, along with a duplex 10 HP pumping station to provide the necessary 250 GPM to the production equipment. While the tower will function well at ground level, Motivair designed a steel structural support to elevate the tower 6 feet, in order to minimize the ingress of airborne contaminants, which can be drawn into the spray system by the centrifugal fans. This reduces the sump blow-down requirements, since dirt, dust, leaves, etc. are always more concentrated at ground level. For year-round, anti-freeze protection, the system was charged with a 40% glycol solution. The duplex pump station was specifically designed and built to fit underneath the tower in order to avoid occupying valuable production floor space inside the building.

Motivair Central Cooling System

CENTRAL COOLING SYSTEM FOR NEW PET AIR COMPRESSORS

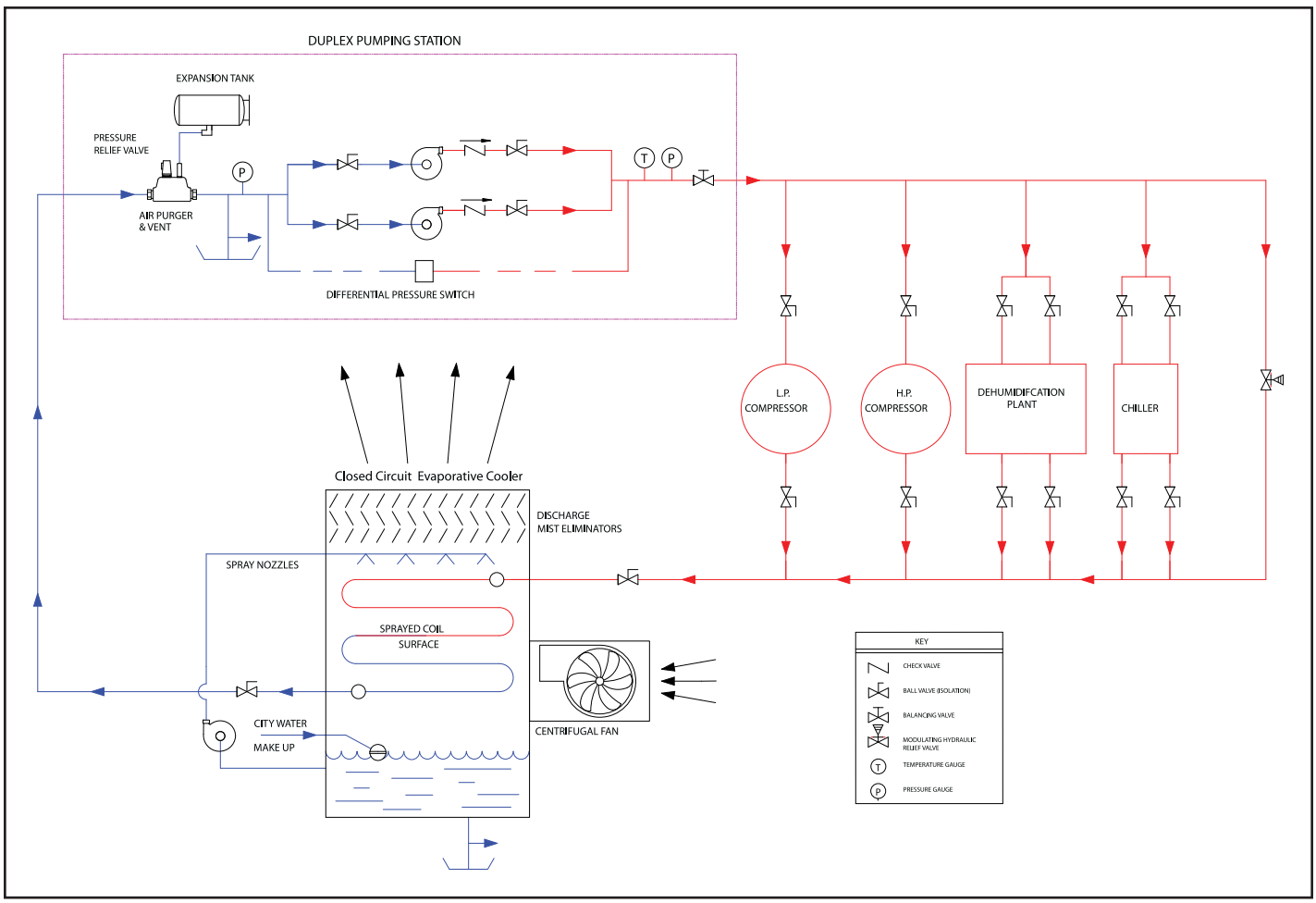
Closed-loop, evaporative-cooling is especially suitable for this application. It offers a close approach to the prevailing wet bulb temperature, while the circulating cooling fluid is never exposed to the ambient air or the spray water. Therefore the cooling fluid inside the equipment is always clean, while water-cooled equipment maintenance is virtually eliminated. The only water treatment required is for the spray makeup water to replace that lost by evaporation. This makeup is approximately 2 GPM per million BTU/h, or 4.1 GPM in the maximum summer design operating conditions.

An energy-saving feature was the addition of automatic cycling controls for the fan motor and spray pump during lower winter temperatures. There is no performance advantage achieved by over-cooling the fluid in winter. Therefore at approximately 60 ºF leaving fluid temperature, the fan motor is stopped to conserve energy, while the spray pump continues to operate. At 50 ºF leaving fluid temperature, the spray pump is also stopped. The adjustable control differential is set sufficiently wide to prevent short-cycling of the fan or pump during winter operation.

The duplex pump station is designed for automatic operation and is electrically connected with the closed loop tower in a common NEMA 4 control panel with interlocked disconnect switch. In the event of a pump malfunction, the alarm is set and the standby pump starts automatically. Pump isolation and check valves, gauges, expansion tank, flow, level and temperature alarms complete the factory-built package. An ASME pressure relief valve ensures equipment and personnel safety in the event there is ever a high-pressure compressed air leak into the cooling system.

Following the success of the Harrisburg central cooling system, similar Motivair cooling packages were installed at the Pepsi bottling plants in Houston, Tampa and Calgary.

For more information, please contact Mr. Graham Whitmore, Motivair Corporation, email: gwhitmore@motivaircorp.com, tel: 716-689-0222, www.motivaircorp.com



THE GREEN INITIATIVES AT PACE INDUSTRIES

BY LAURIE ASPENSON

Founded in 1986, Pace Industries Inc., an EPA Green Power Partner, is the leading extrusion manufacturer of high-impact polystyrene and related products for the graphic arts industry. With a strong emphasis in protecting the environment, Pace continues to be a steward in the area of sustainability as they continue to develop and create products to fulfill and exceed market demands for future generations. The company, located in Reedsburg, Wisconsin, has a "Green Initiatives" strategy, which has recently resulted in being rewarded with a grant for a new compressed air system and recognized as a Green Power Partner.

Pace Vice President of Engineering, Doug Rocket (center), with Utility Company Representatives

THE GREEN INITIATIVES AT PACE INDUSTRIES

Grant Awarded by Wisconsin Public Power

Pace Industries was awarded a grant from Wisconsin Public Power, Inc. (WPPI), the energy supplier for Reedsburg Utility Commission. WPPI's "RFP for Energy Efficiency" program was open to large commercial, industrial and institutional utility customers consuming significant amounts of power. The goal of the program was to help users reduce energy consumption through upgrades to equipment and systems within their current facilities.

Through the RFP program, large commercial customers served by WPPI member utilities were invited to submit competitive bids for funding to make energy-saving improvements. To be considered for incentive funding, customer bids were required to demonstrate a resulting reduction in electrical demand of at least 50 kilowatts during periods of peak energy use. WPPI outlined minimum efficiency requirements for any proposed equipment, and required grant applications to include an external audit, demonstrating current energy consumption, proposed equipment and system changes, and the investment required to meet the energy efficiency goals of WPPI's program.

In review of the WPPI program and in keeping with their "Green Initiatives," Pace felt that the plant's compressed air system was an area that could be improved. The plant uses large quantities of air in many of its manufacturing systems. "We had recently contracted with Industrial Energy Solutions to complete a compressed air audit. Recommendations of the audit showed that the plant compressed air system was inefficient by today's standards and would require a larger investment. Timing couldn't be better as I had just received WPPI's announcement that they were accepting requests to assist in energy efficiency funding," stated Doug Rocket, Pace's VP of Engineering & Facility. Rockett continued, "WPPI's representative Jim Schieble was instrumental in helping tie together our project goals with our collected data. The end result was Pace being awarded $51,000.00 to assist in a project that will exceed $100,000.00 in total costs."

With the grant awarded, Pace intends to move forward by replacing four outdated compressed air units. A new centralized unit will be installed requiring the upsizing of the current piping to move the compressed air throughout the 185,000 square foot manufacturing facility. Efficiencies will be gained by progressing from a multiple unit system that runs continuously, to a single state of the art unit operating at variable speeds, based on demands of the Pace facility. The anticipated completion date is April 2007 and will be followed by a WPPI inspection of the air compression system in May 2007.

"We are very pleased to grant Pace Industries this financial incentive for energy-efficiency improvements," says WPPI Director of Industrial Services Jake Oelke. "Pace presented what WPPI considered to be an ideal application for the program: one where the customer considered a more expensive but more efficient restructuring of their compressed air system in lieu of a simple expansion. We applaud the Pace Industries 'Green Initiatives' effort and extend our congratulations on this energy-saving plant improvement."

Recognition as a Green Power Partner

Pace Industries is recognized as a Green Power Partner by the Environmental Protection Agency (EPA). This honor is awarded to companies that procure a threshold amount of its energy needs by either wind, water, organic materials or other renewable sources.

Pace Industries in Reedsburg, Wisconsin

Pace Industries' manufacturing facility, located in Reedsburg, Wisconsin, has secured a percentage of WPPI's wind turbine power as an alternative energy source instead of the traditional products used such as coal, oil or natural gas. "Right out of the gate, the wind power we are purchasing is the equivalent to 22 tons of coal-generated power. This translates to the amount of power consumed by 52 homes, annually," states Blake Pace, president of Pace Industries. "Pace's green power initiatives have an impact on preserving fossil fuels for future generations and hopefully setting a course for other businesses in selecting alternative natural resources."

Pace Industries' recent recognition as a Green Power Partner complements a corporate culture that focuses on reducing, re-using and recycling products and services for the well-being of employees, customers and environment. Some of the green power initiatives include:

1. Pace Industries continues to explore new bio-based polymers that incorporate agricultural products such as corn or soy beans as alternatives to fossil fuel-based resins.

2. Pace's PS-Absolve is a new engineered polystyrene that looks, feels and processes likes standard styrene but incorporates state-of-art polymer technology, certified by a raw material supplier, to facilitate degradation in litter form, commercial or residential compost as well as in landfill disposal.

3. Customer Recycling Programs offer customers the opportunity to return packaging materials as well as plastic scrap. In order to encourage recycling, an inflated value is offered for these materials. These programs eliminate the potential landfill of at least 2 to 3 million pounds of waste annually.

4. Neighborhood Electric Vehicles (NEV) feature zero emissions for indoor/outdoor operations and can travel 200 miles for the cost of one gallon of gas. Legalized for road use by the Reedsburg community, Pace Industries was the first manufacturer to purchase an NEV for company travel within the cities' limits.

5. Pace provides ongoing Employee Education related to recycling and renewable energy options. As a result of the education, employees are encouraged to participate in minimizing environmental impact at both work and at home.

For more information regarding Pace Industries' Green Initiatives, please e-mail requests to administrator at green@pace-industries-inc.com or contact Laurie Aspenson at tel: 608-524-6777, ext. 323.

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ENERGY-EFFICIENT AIR NOZZLES for the Blow Molding Industry

BY HANK VAN ORMER

As in many industries, most plastic injection molding plants use a great deal of compressed air in "blowing off" the product. It is used to remove cleaning agents and water, to move product along the line and to remove rejected pieces.

The compressed air used in the operations varies from open-tube or pipe-blowing, to quality non-amplifying control and/or dispersion nozzles, to venturi-driven amplifying nozzles. Almost without exception, any "straight" compressed air blow-off, through an open pipe or tube, will be very inefficient and the compressed air used can be reduced by 50% or more.

Two Types of Efficiency Nozzles — Control/Dispersions and Venturi Amplifiers

The open-pipe flows compressed air to the process with very little, if any, amplification. Turbulent compressed air blasts straight out of the pipe or tube. It not only wastes compressed air, but also violates OSHA noise and dead-ended pressure requirements. There are two basic types of efficiency nozzles: dispersion and venturi amplifiers.

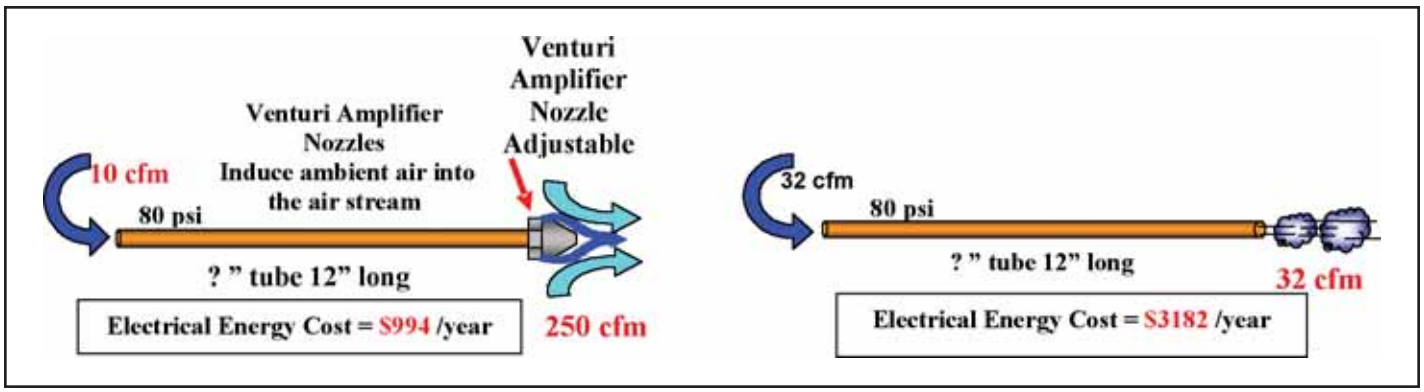
Applying a high-quality non-amplifying dispersion nozzle will reduce this air usage significantly and it will control the air flow. We now have a predictable, repeatable air flow, which when implemented correctly, will be more effective in removal due to a potential optimum blow profile. Applied with properly selected regulators, the compressed air inlet pressure can be adjusted to identify the optimum flow at the lowest effective inlet pressure.

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

- Use high pressure only as a last resort
- All blow-off air should be regulated to the lowest effective pressure — higher pressure means higher flow, which may not be needed
- Use venturi air amplifier nozzles whenever and wherever possible — this will usually reduce blow-off air by at least 50%, freeing up more air flow for other applications
- All blow-off air should be controlled to shut off (automatically) when not needed for production.

Plants with many ⅛" and ¼" open lines running as blow off on units will use approximately 14 and 32 cfm each, respectively, at 80 psig

Another type of nozzle to use is an air amplifier, which requires less compressed air than a non-amplifying nozzle and flows more total air volume at the process with somewhat less thrust. Air amplifiers use "venturi" action to pull in significant amounts of ambient air and mix it directly into the air stream, which amplifies the amount of air available at the point of use. Air amplifiers have amplification ratios up to 25:1. By reducing a 32–cfm demand to 10 cfm of compressed air, they can supply up to 250 cfm of blow-off air to the process and generate a savings of 22 cfm of compressed air per ¼" blow off.



ENERGY-EFFICIENT AIR NOZZLES FOR THE BLOW MOLDING INDUSTRY

Summary — Nozzles

Quality air flow-control, dispersion nozzles and venturi-amplification nozzles reduce noise level, lower compressed air use and often improve blow-off operation in both productivity and quality.

Following are lists of various types of common compressed air blow-off equipment (open blowing, control nozzles and dispersion nozzles) to allow the air usage comparison of each. Venturi-amplifier nozzles usually have amplification ratios ranging from 4:1 to 25:1.

General Comments on These Lists

This data reflect relative data gathered and measured over time. It is relative to specific standard products available in the industry. A test of one nozzle may vary somewhat from another nozzle of the same manufacturer, but not significantly. Some important points to remember:

- In blow off, thrust from pressure (psig) is required to loosen the objects to be removed.
- Thrust dissipates very rapidly once the air has left the "blow-off" device.
- Volume of total air (cfm) — compressed air, plus induced air, is critical to carrying the blown-off material away within the air stream.
  - On all blow-off devices, the higher the inlet pressure of the compressed air to the device, the more compressed air that is consumed.
- All blow-off operations should identify the ideal or optimum entry pressure and control it at that point. Additional pressure uses more air with no process improvements.
- When the blow-off process does not have to be continuous, appropriate controls should be installed to have the blow off operate only when required.

Air Consumption of Typical Open Pipes

Air Consumption of Homemade Blow Offs

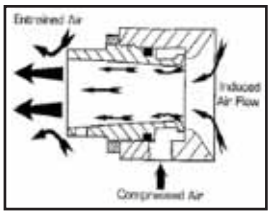
ENTRY PRESSURE	COPPER TUBE (1' LONG)					OPEN PIPE (1' LONG)		
PSIG	⅛"	¼"	5/16"	⅜"	½"	⅛"	¼"	⅜"
20	6	13	22	33	97	27	48	90
40	7	19	33	50	121	40	75	145
60	13	27	45	70	150	55	105	190
80	16	33	58	87	180	70	140	240
100	20	40	70	108	240	85	165	300

Some Typical "Non-Amplifying" Control/Dispersion Blow-Off Nozzles with Published Test Performance

Nozzle Description	Inlet PSI	Tested CFM flow	Amplification
	5	10	Negligible
	10	16	
	20	19	
	40	22	
	60	27	
	80	33	
Nozzle Description	Inlet PSI	Tested CFM flow	
	5	10	Negligible
	10	18	
	20	25	
	40	34	
	60	40	
	80	46	
Nozzle Description	Inlet PSI	Tested CFM flow	
	20	30	Negligible
	40	40	
	60	46	
	80	52	
Nozzle Description	Inlet PSI	Tested CFM flow	
	20	20	Negligible
	40	22	
	60	24	
	80	26	
	100	32	
	Thrust	23	
Nozzle Description	Inlet PSI	Tested CFM flow	
	20	16	Negligible
	40	18	
	60	22	
	80	26	
	100	30	
	Thrust	22	
Nozzle Description	Inlet PSI	Tested CFM flow	
	20	10	Negligible
	40	12	
	60	15	
	80	18	
	100	21	
	Thrust	12.4	
Nozzle Description	Inlet PSI	Tested CFM flow	
	1/8	13	Negligible
	1/4	28	
	3/8	75	
	1/2	126	
	5/8	151	
	3/4	225	

NOTE: Some of the above nozzles were initially designed for liquid spray control and later applied or modified for air. They do limit the amount of air used significantly in relation to the inlet pressure and control or disperse the flow in a much more efficient manner than the open pipe or tube. They do not induce ambient into the air stream to amplify the flow to the process. Venturi amplifiers flow more volume (weight) of air to the process while using significantly less compressed air. The venturi amplifier will deliver more volume but at a lower thrust.

One type of venturi nozzle uses the coanda effect to amplify compressed air 25 times or more with compressed air ejected through a thin opening on the outside perimeter. Another type ejects compressed air through the nozzle. The air travels at very high velocity, creating low pressure along the inner wall of the nozzle, surrounding air and is pulled into the stream at a predetermined amplification.



Some Typical "Amplifying" Efficiency Nozzles

Nozzle Description	Inlet PSI	Tested CFM flow	Amplification
	20	6	25:1
	40	8	
	60	7	
	80	9	
	100	11	
	Thrust	8.3	

Nozzle Description 1/4" Adjustable	CCW turns form closed position	Tested CFM flow @ 60 psi	Amplification
	1/4	12	Variable up to 25:1
	1/2	19	
	3/4	24	
	1	27	
	1 1/2	30	

Nozzle Description	Inlet PSI	Tested CFM flow	Amplification
	20	7	25:1
	40	9	
	60	13	
	80	15	
	100	17	
	Thrust	21	

Nozzle Description	Inlet PSI	Tested CFM flow	Amplification
	20	13	25:1
	40	16	
	60	22	
	80	28	
	100	32	
	Thrust	34	

Nozzle Description	Inlet PSI	Tested CFM flow	Amplification
	20	7	25:1
	40	9	
	60	13	
	80	16	
	100	18	
	Thrust	20	

Nozzle Description	Inlet PSI	Tested CFM flow	Amplification
	20		Adjustable up to 25:1
	40		
	60		
	80	20	
	100		
	Thrust		

Images Courtesy of AiRTX International

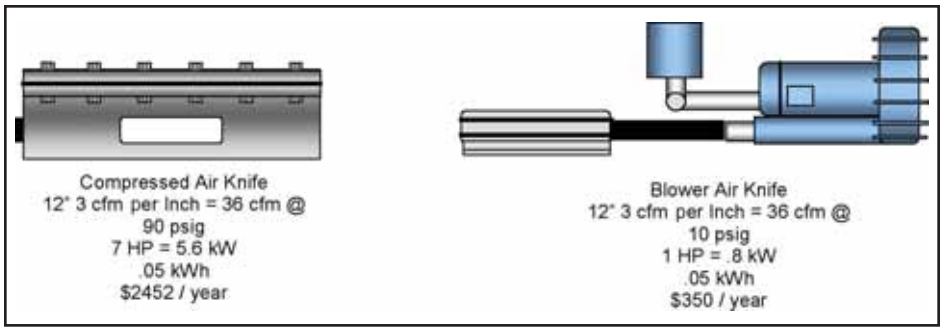
Uncontrolled open blow in a steel plant later replaced with fewer venturi amplifiers

Uncontrolled blow off – later installed photo eye solenoid control for auto shutoff

Tips for Using Air Control and Venturi Amplifier Nozzles

- Always select the lowest flow nozzle that will achieve the desired result to maximize air consumption savings and noise reduction.
- Install a pressure regulator and gauge in the air line before the air control nozzles and regulate pressure down to the absolute minimum necessary to achieve the desired results. Lower pressures improve safety, reduce noise, and could save hundreds of dollars a year in operating costs.
- To minimize noise, increase the distance between the target surface and the nozzle, if possible. Remember that noise is caused by air impacting on the target work piece, particularly edges or holes.
- Install adjustable ball joints, if required, with air control nozzles to provide simple, accurate adjustment of nozzle orientation.
- Do not aim the nozzle straight at the target for cleaning applications. Angle the nozzle 15° to 45° to ensure that the contaminant is removed from the product surface.
- Most nozzles in an appropriate material can be used with CO_2, nitrogen, steam or other compatible gases for special heating or cooling applications.
- To create an air curtain, nozzles do not always need to be positioned as closely as on an air knife. Nozzles can be up to 12" (30 cm) apart, depending on the application.
- You can aim the nozzle to "wipe" sideways across a moving target at a comparatively shallow angle for many blow-off applications. This can reduce the number of nozzles needed.
- Angle the nozzle manifold like a snowplow above a moving conveyor so that the contaminant is forced off the belt, rather than back.
- Proper filtration of compressed air is key for efficient nozzle performance. Be sure to use a filter/separator to remove excess oils and water just prior to your application.

ENERGY-EFFICIENT AIR NOZZLES FOR THE BLOW MOLDING INDUSTRY



Annual Electrical Energy Cost to Produce Compressed Air at Various Pressures

The following information is based on $0.06/kW, 8,000 hrs./yr.; 4.0 cfm per input hp compressor efficiency.

Estimated Electric Energy Cost to produce 500 cfm
@ 100 psig = $43,000 year

Estimated Electric Energy Cost to produce 500 cfm
@ 50 psig = $26,000 year

Estimated Electric Energy Cost to produce 500 cfm
@ 15 psig = $18,000 year

Estimated Electric Energy Cost to produce 500 cfm
@ 7 psig = $8,000 year

The compressed nozzles used in production operations can benefit from quality dispersion nozzles or venturi-driven amplifying nozzles. Almost without exception, any "straight" compressed air blow-off, through an open pipe or tube, will be very inefficient and the compressed air used can be reduced by 50% or more.

Mr. Hank Van Ormer is a leading compressed air systems consultant who has implemented more than 1,200 air improvement projects. He can be contacted at (740) 862-4112, email: hankvanormer@aol.com, and www.airpowerusainc.com.

"There are two basic types of efficiency nozzles: dispersion and venturi amplifiers."

HIGH PRESSURE Growth

Compressed Air Best Practices interviewed Jon von Dobeneck (President), Joe Stark (Operations Manager) and Merv Bohrer (Sales Manager, Industrial Air and Gas Products) of Bauer Compressors, Inc.

Good afternoon! Congratulations on over 30 years in the USA, right?

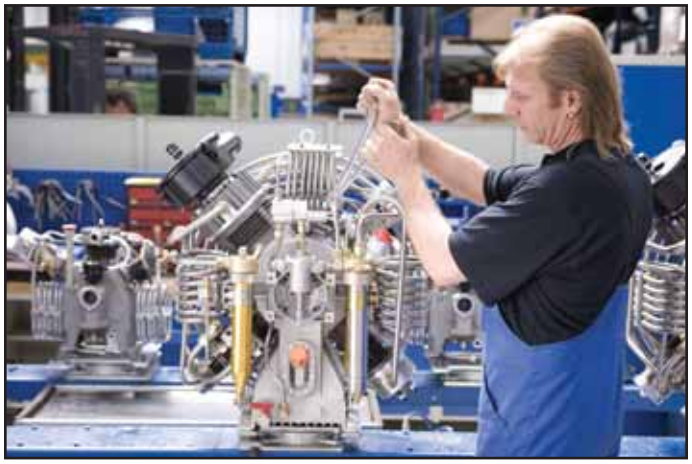
Good afternoon and thank you. Yes, Bauer Compressors, Inc. was founded in 1976 in Norfolk, Virginia. We would like to thank our employees for their commitments to Bauer. We have a veteran and highly skilled workforce with many employees with long tenures with the company. Bauer has been a stable company to work for. Thanks to our people, we have grown to be a U.S. company with over 230 employees and with offices in Miami, Los Angeles, San Francisco, San Diego and Detroit. Our U.S. Headquarters and manufacturing center remains in Norfolk.

Jon von Dobeneck, Merv Bohrer, and Joe Stark of Bauer Compressors (left to right)

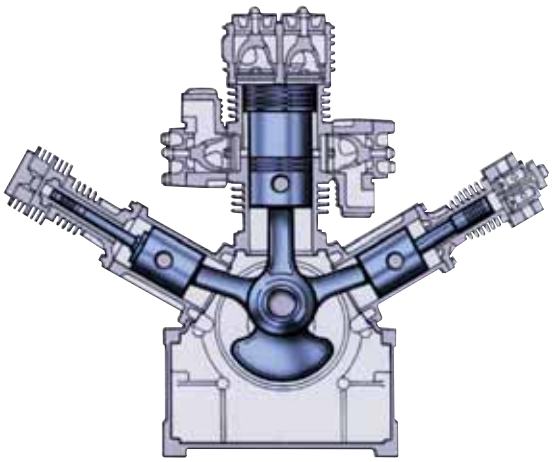
Bauer Compressors, Inc. Norfolk, Virginia

HIGH PRESSURE GROWTH

The Bauer Compressor Block Facility in Germany



A Bauer High-Pressure Compressor Block



Driving Gear on a Bauer Compressor

What is the scope of Bauer internationally?

Bauer has been manufacturing high pressure compressors for more than 60 years. The business began from the Bauer family home in 1946 in Munich, Germany. Since then, Bauer has expanded internationally and now has subsidiaries in Italy, France, Austria, England, Japan, Singapore, China, United Arab Emirates and the United States.

We continue to be a privately held company, with our global headquarters in Munich. The company now has over 700 employees and continues to grow. To support our international growth, Mr. Bauer has invested in many in-house manufacturing capabilities. Bauer operates out of a modern facility (just five years old), located just south of Munich. This is where the core technology, the compressor blocks, are manufactured. We have just finished building a duplicate manufacturing facility next door to take care of the growth experienced over the past five years.

Are the compressor blocks Bauer's core technology?

Yes. As mentioned before, the blocks are made in Germany with the highest emphasis on quality and durability. An example is the driving gear. All bearing surfaces on the driving gear use long life roller or needle bearings for reduced friction and maximum mechanical efficiency. The drive gear is supported in the crankcase with heavy-duty ball bearings. The dynamically counter-balanced crankshaft provides smooth and practically vibration free operation.

So it has been five years of tremendous growth?

Absolutely. We have seen sales growth all over the world for our high pressure compressors. In the United States, the business has more than doubled over the past five years. Another positive has been the fact that our growth has come from all three main segments of our business.

What are the three segments of Bauer's business?

We have three sales divisions in the USA, which provide us with a market focus: industrial air, breathing air and plastics. Our market diversification has been good for us. It is fascinating how many applications there are for high-pressure compressors.

Please describe the industrial air business.

The high pressure industrial market can be challenging, yet we've grown this business each year since 1999. Our industrial distribution network, managed by Merv Bohrer, provides good coverage for Bauer in most of the U.S. We are the market leader in the U.S. in high-pressure industrial air. The primary application is for component testing and calibration. There are, however, many other applications.

The seismic business, for example, has rebounded. We recently received an order for twenty-four (24), 100 horsepower, 5,000 psig compressors. Seismic exploration uses high-pressure air by providing it to seismic guns. The air is compressed and stored at 5,000 psi. When ready for use, the air is regulated down to 2,000–2,200 psi, the typical pressure range for use in seismic guns. The guns are configured in an array and the air is pulsed into the water. On a ship or on land, a device reads the pulses. The deflections of the air tell explorers more about what lies below. Bauer systems are used with the high-resolution diagrams, which measure the smaller fields.

Airborne forest firefighting systems are another interesting application. Many C-130 planes, deployed in firefighting, use 1,200 psig air pressure to eject (through nozzles) the fire retardants they use. This has proven to be an advance over the traditional gravity-drop method and has gained acceptance here. In Europe, all systems use high-pressure air and nozzles.

Crash-test rigs in the automotive industry are another example. When testing seatbelts, a seat is mounted on a pneumatic ram. The ram utilizes compressed air stored at 4,500–5,000 psig, to accelerate and suddenly stop the seat. The seatbelt restraint is tested in this way.

What product do you manufacture for the industrial market?

Bauer manufactures a broad range of industrial compressors and boosters. We provide solutions for applications from 4–206 scfm and 350–7,000 psig. Our engineering and manufacturing teams in Norfolk can provide enclosed, non-enclosed and skid-mounted packages. Our ability to supply custom packages, with quick lead times, has cemented our position as the market leader in high pressure.

5000 psig Compressor for Seismic Exploration

5000 psig Storage System for Seismic Exploration

MAXI Verticus Enclosed Compressor

HIGH PRESSURE GROWTH

INDUSTRIAL APPLICATIONS BETWEEN 2,000–5,000 PSIG

Testing & Calibration
- Pressure Gauges
- Relief Valves
- Valves
- Tubing & Pipe
- Valve Actuators
- Transducers

Research
- Industry
- Educational
- Helium and Argon Recovery

Automotive
- Test Sleds
- Wind Tunnel

Oil & Gas
- Offshore Rig Stabilization
- Pipeline Pressure Testing

Marine
- Cable Compensation
- Air Guns for Seismic

Exploration
- Dockside Air Supply

Aviation
- Engine Starting
- Aircraft Maintenance

Electric Power Plants
- Turbine Starting
- Circuit Breaking

Cylinder Refilling
- Storage
- Paintball
- Air Rifle

How is the Natural Gas business?

Natural gas has lost the spotlight with NGV (Natural Gas Vehicle) larger fleets in favor of bio-diesel and hydrogen. We were there when the NGV fleets were set up and enjoyed a good run of business. Many large transit fleets have gone towards over-the-fence renting of natural gas. Bauer continues to work with smaller fleets, like forklift fleets at the cargo side of an airport. Truck fleets, with fifty or fewer trucks, are also a target. A Long Island beer distributor, for example, uses NGV trucks supplied by Bauer natural gas compressors.

Please describe your Nitrogen Compressors.

Nitrogen compressors are a major product for Bauer. We manufacture compressors for inert gases. Nitrogen is used in many industrial test labs. We also supply compressors for helium (helium recovery systems) and Argon.

Bauer also has a joint venture in California dedicated to providing nitrogen generators for aircraft ground support. The FAA mandates the use of nitrogen in many areas of helicopters and airplanes. Helicopters use nitrogen, under pressure, in the rotor blades as a way to detect leaks. All tires on airplanes are inflated with nitrogen. This joint venture specializes on military applications and has more than 200 units in service.

Breathing air is your second sales division, correct?

Yes. Industrial safety, through breathing air in refineries and other industrial applications, is one part of this division. The larger part comes from supplying high-pressure breathable air to fire departments and diving applications.

Big subsidies for fire departments, through FEMA grants after 9-11, gave this market a big boost over the past few years. Bauer has a comprehensive product line of breathing air compressors and systems. This market has now slowed down, as most breathing air systems at fire departments have been upgraded over the past five years.

We also manufacture our own purifiers, utilizing molecular sieve and catalysts, which we package with our air compressors to provide breathing air.

How is your plastics sales division doing?

Our plastics sales division focuses on gas-assist injection molding. Gas-injection molding is an innovative process that effectively reduces the weight of plastic parts. We have specialists, in our U.S. branches, in the evaluation of molds and who consult with molders on how to implement this new technology. Most television housings, suitcase handles, toilet seats and clothes hangers are produced with the gas-injection molding process. This is a growth market for Bauer as more molding markets adopt this technology.

How does Bauer support so many specialized applications?

Bauer has, as mentioned, invested heavily in technology, infrastructure and people to support our growth. This provides us with competitive advantages. Here in the U.S. we have three manufacturing buildings located in Norfolk. If you look at our aerial photograph, our production flows from right to left through three production buildings. Our office building sits in front of the complex.

Unlike many companies, Bauer continues to be vertically integrated. We want to keep manufacturing "in-house" so we can control quality for our specialized applications. This also allows us to manufacture "specials" with good lead times. Unique to Bauer is the fact that we look for and want to do "one-off" projects.

Providing the engineering know-how for this is our engineering department of 13 people. They are able to go from a customer request, to a 3-D model and then to a prototype, in a matter of weeks. They are in our 9,840 square foot office building, which also houses the other administrative and management functions of the company.

Please describe the production flow through the complex.

The manufacturing Building #1 is dedicated to raw material receiving and fabrication of skids, frames and sheet metal cabinets. This 18,500 square foot facility has several large bridge crane systems with hoists capable of moving large skids and frames. This facility has a automated laser-cutting cell with two 4,000 watt Mitsubishi automated lasers. They have 5' x 10' sheet capacity. They can cut up to 1" plate although most of their work is on ¼" metal plate.

The six welding stations, with MIG and TIG capabilities, have welders certified to AWS standards. There is also a Kawasaki robotic welding machine in the cell. The metal forming cells include Pullmax and Bystronic CNC press brakes and a Salvagnini Roboformer bending cell.

The manufacturing Building #2 is dedicated to painting the packages with a GEMA volstatic powder-paint coating system. It has a 3-stage wash/rinse cycle and a cure oven. This 33,662 square foot facility also has a wet spray-painting cell for larger packages like the skid-mounted Natural Gas Compressors. A full machine shop, manufacturing engineering, customer service, training center, R&D and a service bay are also located in this facility. A calibration lab for gauges and switches is also present, which allows us to fulfill contracts with calibration requirements.

Building #3 is dedicated primarily to assembly. In this 56,480 square foot facility, Bauer has adopted a modular assembly process. Relief valves and pressure switches, for example, are assembled and pre-tested in sub-assembly modules. There is also a sub-assembly area for purification units, electrical panels, wire harnesses, trailer units (DOT approved), dive units and special units. Pre-testing (like pressure testing for leaks) in the sub assembly modules has made the assembly process more efficient and reduced lead times.

Thank you Bauer Compressors for your insights.

For more information, please contact Patrick Smith, Bauer Compressors tel: 757-855-6006, email: Patrick.Smith@bauercomp.com

Welding Small Units

Metal-Forming Area

Bauer Assembly Area

The Inventors of the CYCLING DRYER

Compressed Air Best Practices interviewed Robert Fisher (General Manager) of ZEKS Compressed Air Solutions

ZEKS MultiPlex™ Large-Capacity Refrigerated Dryer

Good morning! How are things at ZEKS?

Good morning. Business at ZEKS has been strong, thank you. As a single-source supplier of compressed air treatment products, we have been enjoying significant growth. While we are known most for our cycling refrigerated dryers, all of our product lines have been strong, especially our new line of desiccant dryers introduced early last year.

Can you quickly review how ZEKS was started?

Sure. ZEKS was founded in 1959 by four former Honeywell employees, whose initials form the company name. The founders had experience with non-cycling refrigerated dryers for the pneumatic controls of HVAC systems. They felt they could find a way to turn off the refrigeration compressor when there was no load on the dryer and thereby save energy. Sure enough, the founders patented in 1959 the first compressed air dryer to include a refrigeration system that cycled on and off — combined with a thermal storage module to store cold energy and maintain dew point during low load periods. They began their work with small flows lower than 50 scfm. The technology, however, proved to be a natural for large-capacity applications where energy savings could be very significant.

How has the market for cycling air dryers evolved over the years?

Cycling dryers have historically carried a premium price over non-cycling dryers. The premium has been more than justified by the energy-saving capabilities of the technology, especially on larger systems. ZEKS has enjoyed dominant market shares, for this reason, in large applications with air flows in excess of 3,000 scfm.

The continued education of the end user, on the costs associated with compressed air, has increased the demand for cycling dryers. Cycling dryers now show faster market growth than non-cycling dryers. The introduction of energy rebates, by utility companies, has helped cycling technology. In the high energy-cost regions of North America, cycling dryers often qualify for rebates. End users today, begin calculating the benefits of cycling technology with installations starting at 200 scfm! As you can imagine, this has increased the target market substantially for our core technology. The result of the enhanced energy-awareness of end users has been an increasing market share for ZEKS.

ZEKS COMPRESSED AIR SOLUTIONS®

Please describe the evolution of ZEKS cycling dryers.

ZEKS has an installed base of well over 100,000 dryers. We are continually looking at ways to improve our technology, while retaining our reputation for quality products. Our cycling dryers utilize similar storage media, as before, and have evolved in the areas of heat exchangers, refrigerants and modular design.

What is your view on storage media?

The storage media (or thermal mass) is where cold energy is stored when the refrigeration compressor turns off. ZEKS utilizes a propylene glycol/water mixture. The reason is that the specific heat of this medium is five times less that of other mediums being utilized by other companies. Other firms have tried sand, refrigerant, aluminum, etc., for the storage media. The results we've seen from tests of these other methods of thermal storage have been less than optimal. Results range from varying dew points and/or excessive refrigeration compressor cycling. Another result is they sometimes require up to five times the weight of storage media to approach the performance of the ZEKS design. If they don't put in the weight, then other symptoms can occur such as the aforementioned dew point fluctuations and excessive compressor cycling.

Heat exchangers have changed at ZEKS, right?

Yes. John Bergh, our Engineering Manager, began working on a new line of stainless steel heat exchangers in 1996. We started replacing our copper heat exchangers in dryers above 50 scfm in 1999 with these patented CFX™ stainless steel heat exchangers. The new technology provides greater resistance to leaks and lower pressure drops. The results have been phenomenal for our customers and for our company.

The plastic blow molding market actually provided some of the impetus to begin researching different heat exchanger options. We had a customer, involved with PET blow molding, who had purchased several dryers and reported some leaks in the heat exchanger coils. We did an analysis of the heat exchangers and found the copper had been attacked by corrosive agents. After further analysis with the customer, we found that the polyethylene pre-forms off-gas a chemical vapor, when sitting in storage in the warehouse or on the bottling line. This vapor is an organic acid with a pH as low as 3, which is particularly aggressive towards copper. The gas was being drawn into the intake of the air compressor and causing damage in the heat exchangers of both the compressor's aftercoolers and in the heat exchanger of the air dryer. Since switching to stainless steel, we have seen zero problems. Our PETX™ high-pressure air dryer has been very successful for the PET container market. The line features our CFX™ heat exchangers and has models for 120 to 4,300 scfm capacities.

ZEKS PETX™ High-Pressure Refrigerated Air Dryer

"ZEKS invented the cycling refrigerated air dryer in 1959."

THE INVENTORS OF THE CYCLING DRYER

CFX™ Heat Exchangers

Why are the pressure drops so low on the CFX™ heat exchangers?

As part of our stance as a supplier of energy-efficient air treatment products, we designed our heat exchangers to minimize pressure drop. Not only does the low pressure drop save energy, but it can minimize the need for additional air compressor horsepower. This means that we designed our heat exchangers from a flow standpoint, rather than from a heat-transfer standpoint. Our design criteria, was a 1 psig pressure drop, per exchanger pass, in a three-pass design. The total allowable pressure drop was 3 psig.

These patented heat exchangers have 3–5 times the flow area of other heat exchangers. A key design element is the rounded inlet to the exchanger surface. This large, smooth, inlet provides an extended flow path for the inlet air. Some plate heat exchangers have a sharp-edge orifice at the inlet, which creates pressure drop at that edge.

The corrugated surface of the heat exchanger is folded, crossed and compressed into the shell of the exchanger. The design results with a spring-loaded effect, which tolerates freeze-ups and pulsation. By not having braze joints at the crosses, we reduce the number of weld points vulnerable to expanding ice in a freeze-up condition. This is something that users of other plate heat exchangers can experience.

> "PET pre-forms off-gas an organic acid that can damage copper heat exchangers."

The shell of the heat exchanger is cylindrical, as opposed to the rectangular casings of most heat exchangers. Becausethe shell is cylindrical, it makes for a nice pressure vessel. We decided to provide our customers with an extra level of safety by designing the shells to ASME specifications. While not required, the burst pressure of these heat exchangers is 7,000 psig, providing customers with an extra level of safety.

Where is the market going with refrigerants?

R-22, a refrigerant that is commonly used in dryer applications, is very efficient. It is, of course, being phased-out by the Montreal Protocol in favor of CFC-Free refrigerants. At ZEKS, we studied all the alternatives to R-22 and have gone in the direction of R-404a. We also use R-407c on some of our larger models. Although R-407c does have a larger glide factor, we have found we can engineer our dryers to a stable dew point utilizing R-407c.

We watch the commercial refrigeration and air conditioning industries for future trends in refrigerants. Currently, a very promising high-efficiency refrigerant is R-410a. It is used in many high-efficiency air conditioning applications. Prices are still high, availability is limited and the compressors that can work at its higher design pressures are expensive. We do expect this to be an important refrigerant in the future as the technology matures.

Let's talk about modularity and redundancy.

Many end users have multiple air dryers in their facility, each of which is creating a pressure drop of, on average, 5 psig. Servicing multiple dryers also creates challenges in finding times when they are off-load to work on them. When the business of a customer grows, more dryers are added, which make the system even less efficient and more complex. Our customers asked us to find a solution to these problems.

The solution arrived more than 15 years ago with the introduction of the MultiPlex™ Series of cycling refrigerated air dryers. These dryers are made up of multiple, independent, cycling air treatment modules — within one large dryer. In 2002, we redesigned these dryers with our CFX™ heat exchangers. The modules share a single inlet header and a single outlet header, each with dual connection capability for installation versatility. The modules turn on and off as the load characteristics require, to deliver energy savings of up to 80%. We currently manufacture units of up to 8 modules for an air flow of 19,200 scfm.

Expandability is also possible as the header centerline position is common among all the models (4,000 scfm and larger). This feature enables users to "bolt-on" additional units as operations expand. Dryer operations, of all the modules, is automatically controlled and synchronized to optimize energy savings. A PLC manages the appropriate loading and unloading of the modules required to maintain dew point. A backlit LCD display provides the user with operating information and a control interface.

Finally, the design is great for service because each module can be isolated from the others. This allows for service to be performed on the module while the other modules are in operation. The other benefit is that all the modules are the same in design. This leads to increased levels of familiarity and expertise by service technicians.

On another topic, what does the Ingersoll Rand acquisition mean for ZEKS?

Ingersoll Rand acquired ZEKS on September 1, 2006. The previous owner had purchased ZEKS in 1996. One of the reasons Ingersoll Rand was seen as an attractive buyer was the additional volume that they could bring to the ZEKS facility. Ingersoll Rand also has a great deal of knowledge of the markets outside of North America where ZEKS has been weak.

ZEKS will be producing certain dryer products under the Ingersoll Rand name for Ingersoll Rand. There will be a degree of differentiation between ZEKS and Ingersoll Rand products. The sales, marketing and service of the Ingersoll Rand business is completely separate from the ZEKS business. The ZEKS Regional Managers as well as Inside Sales will continue to be 100% focused on ZEKS equipment and ZEKS distributors.

THE INVENTORS OF THE CYCLING DRYER

How is the factory equipped?

ZEKS is located in West Chester, PA, which is approximately 30 miles west of Philadelphia. ZEKS operates out of a 75,000 square foot facility, on 11.8 acres, which was constructed in January of 1999. We have been adding personnel and investing in their training in order to support the expanding ZEKS sales as well as the Ingersoll Rand requirements. We are focused on "growing well" and must maintain our 98% average with on-time deliveries and our history of quality products. For the future, we also have the capability to expand operations on this property.

What changes do you see in the industry?

A significant change is the beginning of the CAGI (Compressed Air & Gas Institute) Performance and Verification Program for air compressors (50–200 hp compressors) and refrigerated dryers (200–1,000 scfm). The program is moving forward on air compressors and will begin with the dryers later this year. We are excited about the program. The benefits to end users are to assure them of receiving the quality they perceive to have purchased. Dryer dew point performance has been an area of discussion in the past. I was the Chairman of the CAGI Dryer and Filtration Section for four years, and am glad to have collaborated with my colleagues in the dryer industry to bring this program to reality.

What is in the future for ZEKS?

We will continue to differentiate ourselves from our competition through product innovation and outstanding distributor support. In addition with access to additional resources, we expect to be able to introduce additional ZEKS products to the market that we may not have been able to do in the past.

Thank you ZEKS for your insights.

For more information, please contact Robert Fisher, General Manager, ZEKS Compressed Air Solutions, tel: 610-692-9100, or visit www.zeks.com

HOPE
FOR BLOW MOLDERS

Compressed Air Best Practices interviewed Peter Rhoten (President) of Hope Air Systems

The Hope Air Systems ISO 9001:2000 Certified Facility in Northborough, Massachusetts

Good afternoon. When was Hope Air Systems founded?

The Hope Group is a multi-divisional corporation with more than 120 employees. We have been family-owned since 1933. We began with industrial rubber, fluid power and fluid connector products. The company created Hope Air Systems in the 1960s, as a Division to carry stationary air compressors, dryers, blowers and other compressed air systems to the New England marketplace. We began the culture of consultative selling in the 1970s, and this led Hope Air Systems to become actively engaged with the PET market and with compressed air auditing. Our headquarters is in a 60,000 square foot facility, 25 miles west of Boston. We operate five other facilities, in New England, which function as service centers.

Hope Air Systems has a strong team of sales engineers and service technicians. We are also capable of building custom packages, including PET packages, in our Sorensen Systems Division, which has a large fabrication shop. This division has 5 on-staff engineers and 10 fabrication technicians, which support Hope Air Systems.

HOPE FOR BLOW MOLDERS

3-Stage High-Pressure Package for Venezuela

How did Hope Air get so involved with the PET market?

We began working with PET applications in 1979, when an existing customer bought some of the first blow molding machines. They were Nissei ASB, one-step blow molding machines. Plastic pellets went in one end of the machine, and a clear bottle, with a black plastic base-cup, came out the other end. Our customer needed to set up a 250 psig compressed air system, and that is how we began working with PET applications.

How has the PET business evolved for you?

We have become a leading supplier of compressed air systems, to blow molders in the small and medium-volume market. We have installed hundreds of systems globally, from Tibet to Togo. The blow molding market has had its ups and downs. Mexico was very strong in the 1990s. We have installed over 120 systems, for example, in Mexico. The U.S. is seeing a resurgence with the growing popularity of customized plastic bottles.

We also provide compressed air auditing services to high-volume stretch blow molders. We identify opportunities for them to reduce the energy costs related to compressed air. We also help them plan for production increases.

> "Our primary focus is to help the blow molder achieve their objectives in manufacturing plastic bottles."

How do you assist the blow molders?

Our primary focus is to help the blow molder achieve their objectives in manufacturing plastic bottles. In order to do that, Hope Air has developed an expertise in the one-step blow molding machines that are purchased — and what kind of compressed air supply allows each model to provide optimal performance. Nissei ASB and AOKI, for example, are the market leaders in one-step blow molding. We have worked for years with their technical departments to better understand the specific compressed air requirements of their blowers. What kind of operation air and average blow air does each model require? We work with the blow molders to help them understand the requirements of the blow molding machines they have purchased.

Table 1: Typical Blow Molding Machine Air Requirements

BLOW MACHINE MODEL	OPERATION AIR @ 140 PSI CFM	AVERAGE BLOW AIR @ 500 PSI CFM	BLOW MACHINE MODEL	OPERATION AIR @ 140 PSI CFM	AVERAGE BLOW AIR @ 500 PSI CFM
PF3-1B	44	106	ASB650EXIII	56	81
PF3-1BH	40	110	ASB650EXHD	56	168
PF3-1BHL	40	167	ASB300DP	119	158
PF4-1B	55	142			
PF4-1BH	49	142	NB10LC	20	23
PF6-2B	39	109	NB20LC	10	40
PF6-4B	59	128	NB20SC	14	40

Source: Hope Air Systems

The kind of bottle being blown has a big impact on the air system, right?

Absolutely. After we ascertain which blow molding machine(s) they have purchased, we work with them to understand their production goals. What type of bottle is being produced: food, beverage or cosmetic? What is the maximum size of the bottle? How many bottles per hour will be produced and how many cavities are there? We also work with the blow molder to answer these questions for the demand levels they anticipate two to three years down the road. In this way, we can design a compressed air system that optimizes their current production and which is expandable in the future.

200 HP Booster Package for Milk Bottle Producer

HOPE FOR BLOW MOLDERS

Skid-Mounted PET Air Compressor System

What is the next step in the process?

We evaluate the site conditions and preferences in compressed air supply of the end users. Compressed air is the single highest maintenance item on a PET blow-molding system. It also represents a significant percentage of the capital costs required to set up a blow-molding line. Utilization of the machines is normally 24/7, five to seven days a week. In a year, blow molders often log 6,000 hours and up, with better than a 95% utilization rate. In addition, they have not historically bought back-up (redundant) units.

Blow molders, therefore, tend to have their own preferences and opinions on compressed air. We listen to them and review many variables, like whether or not they want an oil-free compressor or are they ok with oil filtration systems; do they have cooling water, etc. Altitude is a big factor some people forget about. A blow-molding operation, for example, located in Pueblo, Colorado, requires 30% more air than an identical facility in Los Angeles. A production engineer putting in an identical blow-molding line, in a different location, may not remember that.

And now you can recommend a compressed air system?

Correct. After reviewing all of these questions with the blow molder, we are now prepared to make recommendations. We understand their objectives, their site characteristics and the type of blow-molding machine using the compressed air. The availability of capital can also play a role in the blow molders decision-making process when selecting a compressed air system. We can supply a blow molder with up to three types of packages, which we customize in our fabrication facility.

1. **SBK System —** Consists of a rotary screw compressor, a lubricated booster, a refrigerated high-pressure dryer and a three-step filtration system with no air-loss condensate drains. These require the least amount of capital and are often used to produce bottles that do not come into contact with food — like plastic soap containers.

2. **SB System —** Consists of a rotary screw compressor, a low-speed/oil-free booster, a refrigerated high-pressure dryer and a three-step filtration system with no air-loss condensate drains.

3. **HAF System —** Consists of a high-pressure reciprocating compressor, a high-pressure refrigerated air dryer, particulate and coalescing filters and a storage tank.

Installation Questions for Blow Molders

1. Preference for oil-free or oil-free filtered air?
2. Is cooling water available?
3. What space is available inside or outside?
4. Site conditions — altitude/ temperatures?
5. Backup or multiple units?

Table 2: Operation Air and Blow Air Capabilities (Example for 15 hp)

SYSTEM TYPE	COMPRESSOR MODEL	OPERATION AIR CFM @ 140 PSI	OPERATION AIR HP	BLOW AIR CFM @ 500 PSI	BLOW AIR HP
Lubricated Booster	SBK212	38	30	75	15
Oil-Free Booster	SBB218/34/35	35	30	77	15

Source: Hope Air Systems

Table 3: Decision Variables to Consider between Systems

SYSTEM TYPE	ROTARY SCREW COMPRESSOR + LUBRICATED BOOSTER	ROTARY SCREW COMPRESSOR + OIL-FREE BOOSTER	OIL-FREE 3-STAGE COMPRESSOR
Capital Cost	Least	Moderate	Higher
Maintenance Cost	Low	Moderate	High
Cooling System	Air-cooled Booster	Water-cooled Booster	Water-cooled
Noise Level	Moderate	Low	High
Life Cycle	10 year	15 year	20 year
Filtration	Critical Need for Monthly Change	Critical Need for Six-Month Change	Not Available
Operation Air	Available	Available	Not Available

Source: Hope Air Systems

What other services do you provide the blow molders?

As mentioned, most blow molders run 24/7. Once the blow molder has purchased the compressed air system, we help them set up the installations and set up a reliable technical service support system. Knowing what piping to set up in a PET System is the first challenge. We supply our customers with charts and tables and help them purchase the right products. On technical service, our service technicians will normally perform a routine preventative maintenance visit once a quarter. We also qualify and contract with a local service organization, who can support the customer 24/7.

> "In a year, blow molders often log 6,000 hours and up, with better than a 95% utilization rate."

Table 4: PET Piping (example chart)

PSI		125–140	360	508	580
KG		8–10	25	35	40
PIPE/FITTINGS		SCHED 40/H FITTINGS	SCHED 80/XH FITTINGS SCHED 40 SEAMLESS		
CFM	L/M				
40	1,000	1"	1"	1"	1"
80	2,000	1½"	1"	1"	1"
120	3,000	1½"	1½"	1"	1"
160	4,000	1½"	1½"	1½"	1½"
200	5,000	1½"	1½"	1½"	1½"
240	6,000	2"	1½"	1½"	1½"
320	8,000	2"	1½"	1½"	1½"
400	10,000	2½"	2"	2"	2"
600	15,000	2½"	2½"	2"	2"
800	20,000	3"	2½"	2½"	2½"
1000	25,000	3"	2½"	2½"	2½"
1200	30,000	4"	3"	3"	3"
1600	40,000	4"	3"	3"	3"

Source: Hope Air Systems

Thank you Hope Air Systems for your insights.

For more information, please contact Peter Rhoten, Hope Air Systems, tel: 508-351-1834, email: prhoten@hopeair.com

EXPANDING PRODUCTION AT A PET PACKAGING PLANT

(Continued from page 18)

Situation Analysis Part III — The Low Pressure System

The low-pressure system is used to provide operation air to most of the blow molders. It is also used as plant air for conveyor, palletizer and other plant operations. All of the points of use observed had FRL arrangements with pressure settings ranging from 80 psi to 110 psi. At a point farthest from the compressor room, the supply pressure was 100 psi, indicating an overall system pressure drop of 8–10 psi. This is very good for a system this size — not using a demand controller.

> "At loads below 90%, load/no-load would be more energy efficient."

The low-pressure system consists of two compressors with dedicated air treatment products. All the equipment is water-cooled.

1. Ingersoll Rand EP200 single-stage, oil-flooded, rotary screw compressor
   a. 34,760 total hours and 26,876 loaded hours,
   b. Running load/no-load, 110 psi load, 116 psi unload
   c. 892 cfm at 125 psi, short cycling — varying load times (9–40 seconds), unload time max. 7 seconds
   d. 3 psi separator pressure drop
   e. Piped to a Ingersoll-Rand DXR1000 refrigerated dryer
   f. 1,020-gallon receiver tank
   g. Ingersoll Rand IR1000CHE coalescing filter
2. Ingersoll Rand 1CV12M2 Centac, oil-free, centrifugal compressor
   a. 1,166 cfm at 110 psig
   b. Running in modulation
   c. Rebuilt approximately one year ago
   d. Clark Electric 300 HP motor rated at 331 FLA
   e. Monitor indicated operating at 330–340 amps
   f. Ingersoll Rand TS1200 dryer

The EP200 was observed to have very short load/unload cycles. The compressor loads at 110 psi and unloads at 116 psi. Typically, load/no-load installations use a delta P of 10–15 psi. Maintenance reported that the EP200 is set on such a small delta P to prevent the Centac from surging due to back pressure. Since it appears that the EP200 is running at 90%+, it may make sense to run the EP200 in modulation to prevent short cycling of the compressor. At loads below 90%, load/no-load would be more energy efficient. With the current unload time being nominally 5–6 seconds, the sump does not completely blow down, meaning the full energy savings of load/no-load operation is not achieved.

The Centac is running in modulation mode and was observed to be running smoothly. The Centac takes its air from and filter located outside on the roof. Using hot, outside air will cause the Centac to lose capacity dramatically because it is a dynamic machine. Conversely, on cold days the Centac will increase capacity.

The piping system consists of a main 4" loop that reduces to 2" shortly into the plant. There are numerous branches and drops. Point-of-use regulation seems to do a good job, as the pressure drop in the system is on the order of 8–10 psi for 1,000' plus of piping. There is a cross-over regulator off of Belliss #1 that can provide back-up air, if required and if there is sufficient high-pressure capacity.

Low-Pressure System Conclusions

The low-pressure system appears to be adequate for the planned expansion. However, any additional air-using equipment should be carefully considered to ensure that there is sufficient low-pressure air. Please note this is a qualitative analysis and should be followed up with flow metering to determine actual use. In addition, flow and kW metering could determine areas for energy savings, such as demand flow controllers, extra storage and other possible equipment.

If either the rotary or centrifugal are down for maintenance, there is not enough plant air. The centrifugal appears to be running approximately 60%–70% loaded and the rotary is running 80–90% loaded. Based on the machine flow ratings, the centrifugal load is about 755 cfm (65%) and the rotary load is also about 755 cfm (85%). The leftover capacity is about 407 cfm in the centrifugal and 137 cfm in the rotary, for a total of 544 cfm in reserve capacity. There is a cross-over reducer to the high-pressure system, but its availability is uncertain due to demand limits in the high-pressure system.

There is no backup in the low-pressure air system. Based on current demand, an additional Ingersoll Rand EP200 system would be sufficient. However, there are more energy-efficient solutions available and if other changes are made, cascading pressure-reducers from the high-pressure and medium-pressure system could provide sufficient backup.

Situation Analysis Part IV: Energy Costs Associated with Compressor Systems

The electrical energy costs, required to run both the low-pressure and high-pressure systems, is outlined below. The low-pressure system, providing 110 psi air, is estimated to cost $139,721 per year. The high-pressure system, providing 600, 500 and 150 psi air, is estimated to generate $512,278 in kW costs per year. The total kW energy costs for the current system are estimated at $651,999.

Table 5: Current System kW Costs (including use of the proposed Aoki and Mag)

	MODEL	CFM	FULL LOAD KW	KW/YR	COST @ $.038 PER KWH	
Centac	1CV	1166 lcfm	243.3	2,130,965	$80,977	
SSR	EP200	892 cfm	176.5	1,545,905	$58,744	
					$139,721	110 psi Cost
Based on 4,563 cfm demand, including reducing valve losses and 150 psi use						
Belliss 1	WH28	730 cfm	227.7	1,116,967	$42,445	50% loaded
Belliss 2	WH28	730 cfm	227.7	1,994,583	$75,794	
Belliss 3	WH28	730 cfm	227.7	1,994,583	$75,794	
Belliss 4	WH40	1,100 cfm	389.2	3,409,544	$129,563	
Belliss 5	WH28	730 cfm	227.7	1,555,775	$59,119	75% loaded
Belliss 6	WH28	1,100 cfm	389.2	3,409,544	$129,563	
					$512,278	600, 500 and 150 psi Cost
					$651,999	Total kW Cost

Action Plan: Three Alternatives to Consider

The objective is to provide this PET packaging facility with an air system that will allow it to expand, with the best return-on-investment possible. Providing for some type of backup would also be a positive factor. The facility has requirements for air at 110 psi, 150 psi, 500 psi and 600 psi. There are three alternatives to consider:

1. Install a new, 600 psi, high-pressure Bellis & Morcom System
2. Install a dedicated 150 psi Compressor System and Piping Loop
3. Install a dedicated 150 psi Compressor System and Piping Loop — and a dedicated 500 psi Piping Loop

Action Plan Alternative 1: Installing a New 600 psi System

The anticipated demand is such that a new Bellis & Morcom System would primarily stand idle. It would be used during the peak production periods in the hot summer months, when the current system isn't quite sufficient. This alternative is rejected as energy costs would be increased by roughly $5,000 and the capital cost requirement would be $340,000.

Action Plan Alternative 2: Installing a New 150 psi System

This alternative involves installing a dedicated air compressor to supply 150 psi air, through a dedicated 150 psi piping loop. This would allow the Belliss & Morcom compressors to be set up to unload and rotate properly. As mentioned, the use of regulators for 500 psi and 150 psi air introduces a huge inefficiency in the high-pressure system. The pressure-reducing valves/regulators introduce up to a 30% loss. This also allows for backup capabilities in the high-pressure system.

EXPANDING PRODUCTION AT A PET PACKAGING PLANT

Alternative 2 would generate energy savings (in kW) of $106,908 versus the current system. Capital costs for the dedicated 150 psi air compressor system ($175,000) and piping loop ($50,000) are estimated at $225,000. The simple ROI payback is 2.1 years.

Table 6: kW Cost Analysis with a Dedicated 150 psi System

	MODEL	CFM	FULL LOAD KW	KW/YR	COST @ $.038 PER KWH	
150 psi	HPE450-2S	1,994 cfm	347.0	2,698,080	$102,527	150 psi Cost (86% loaded)
*Belliss system less 1,504 150 psi + 617 cfm [1,504 * .41 red loss] = 2,121 cfm Resulting in 4,406 - 2,121 = 2,285 cfm*						
Belliss 1	WH28	730 cfm	227.7	134,036	$5,093	12% kW for stand-by operation to rotate
Belliss 2	WH28	730 cfm	227.7	134,036	$5,093	12% kW for stand-by operation to rotate
Belliss 3	WH28	730 cfm	227.7	134,036	$5,093	12% kW for stand-by operation to rotate
Belliss 4	WH40	1,100 cfm	389.2	3,409,544	$129,563	
Belliss 5	WH28	730 cfm	227.7	748,368	$28,438	29% loaded
Belliss 6	WH28	1,100 cfm	389.2	3,409,544	$129,563	
					$302,843	600 and 500 psi Cost
					$139,721	110 psi Cost-Existing
					$545,091	Total kW Costs
					$106,908	Savings vs. Current System

Action Plan Alternative 3: Installing a New 500 psi Piping Loop in Addition to the New 150 psi System

Alternative 3 involves moving the 500 psi requirements to a separate 500 psi piping loop. This would eliminate the inefficiencies caused by regulating 600 psi air down to 500 psi. This would also allow the pressure settings on the selected Bellis & Morcom compressors to be reduced from 620 psi to 500 psi. This would result in an approximate savings of 6% in BHP.

The actions detailed in Alternative 2 would also be realized as part of this scenario.

Alternative 3 would generate energy savings (in kW) of $190,571 versus the current system. Capital costs for the dedicated 150 psi air compressor system ($175,000), 150 psi piping loop ($50,000) and 500 psi piping loop ($75,000), are estimated at $300,000. The simple ROI payback is 1.57 years.

Table 7: kW Cost Analysis with a Dedicated 150 psi System and a 500 psi Loop

	MODEL	CFM	FULL LOAD KW	KW/YR	COST @ $.038 PER KWH	
1401 cfm at 600 psi and 414 cfm at 500 psi						
Belliss 1	WH28	730 cfm	227.7	134,036	$5,093	12% kW for stand-by operation to rotate
Belliss 2	WH28	730 cfm	227.7	134,036	$5,093	12% kW for stand-by operation to rotate
Belliss 3	WH28	730 cfm	227.7	695,711	$26,437	41% loaded, 600 psi
Belliss 4	WH40	1,100 cfm	389.2	229,121	$8,707	12% kW for stand-by operation
Belliss 5	WH28	730 cfm	214.0	1,165,443	$44,287	57% loaded, 500 psi
Belliss 6	WH28	1,100 cfm	389.2	3,409,544	$129,563	100% loaded, 600 psi
					$219,180	600 and 500 psi Cost
					$102,527	150 psi Cost-Alternative 2
					$139,721	110 psi Cost-Existing
					$461,428	Total kW Cost
					$190,571	Savings vs. Current System

Conclusion and Final Recommendations

The systems in this PET packaging facility are in good condition and marginally meet all of the plant demands. The proposals, detailed in Alternative 3, provide the best alternative for this plant to meet the challenges of expansion.

Recommended course of action in Alternative 3:

1. Remove the 150 psi use from the Aokis and Husky by installing a dedicated 150 psi system. This will free up significant air from the Belliss & Morcom machines and produce cost savings resulting in a simple ROI of 1.98 years. This is achieved through a more efficient compressor operating at 150 psi and eliminating losses from dependency on pressure reducing/regulator valves. An additional benefit is that this would free up the demand on at least one compressor so that the compressors can be rotated properly and there would be excess capacity to meet future expansion.

2. Create a 500 psi loop in the plant to further reduce load on the Belliss & Morcoms. Introducing this loop will bring the ROI down to 1.52 years. This can be done as a project separate from the addition of the 150 psi system.

For more information, please contact Mr. Peter Rhoten, Hope Air Systems, tel: 508-351-1834, email: prhoten@hopeair.com

INDUSTRY NEWS

Press Releases

ONSET COMPUTER CORPORATION ANNOUNCES 2007 PRODUCT CATALOG

onset

BOURNE, MA, January 16, 2007 — Onset Computer Corporation, a leading supplier of battery-powered data loggers, today announced the availability of its 2007 Indoor Monitoring product catalog.

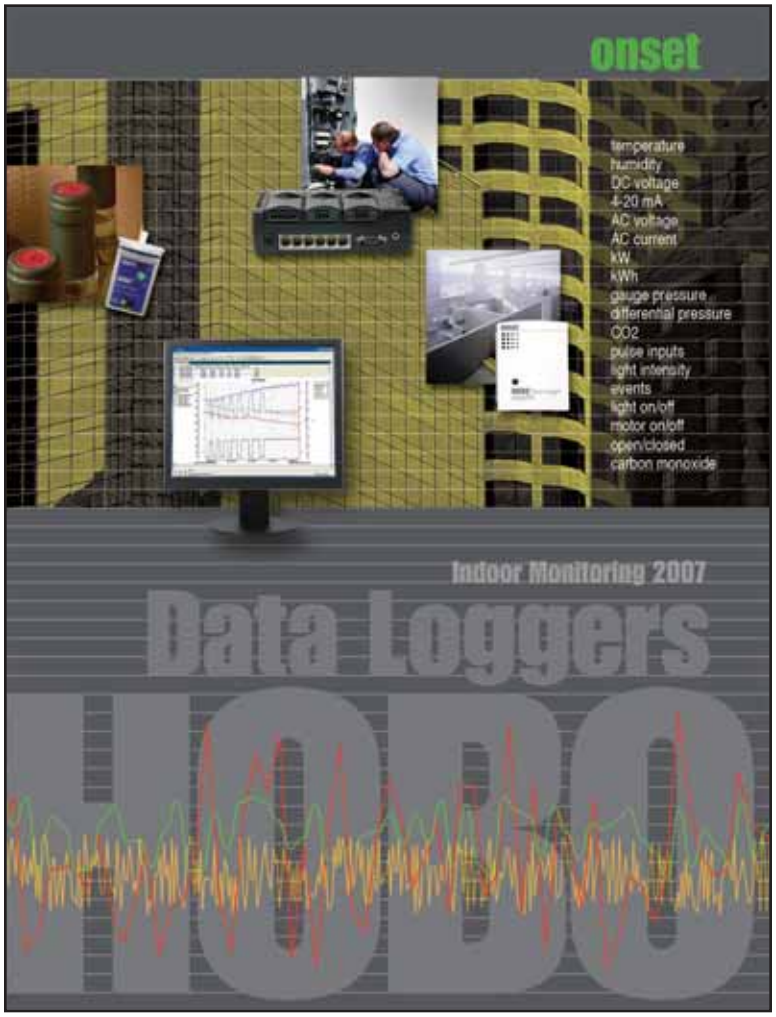
The catalog offers product descriptions, specifications and prices for a full line of PC and Mac-based HOBO® data loggers for indoor monitoring applications.

A number of new hardware and software products are highlighted, including Onset's new HOBO Energy Logger Pro for energy monitoring and new alarm software that provides real-time notification of environmental conditions via email, pager and text messaging.

To receive a copy of the catalog, please visit http://www.onsetcomp.com or call 1-800-LOGGERS.

About Onset

Onset Computer Corporation has been producing small, inexpensive, battery-powered data loggers and embedded controllers since 1981, and has sold more than 1,000,000 loggers that are used throughout the world by more than 50,000 customers. The company manufactures a broad range of data logger and weather station products that are used to measure temperature, humidity, light intensity, voltage and a broad range of other parameters. Onset products are used in a wide range of research, commercial, industrial and educational applications.



MEDIA CONTACT
Evan Lubofsky, Public Relations Manager
Onset Computer Corporation
Tel. 508-743-3181
evan_lubofsky@onsetcomp.com

READER CONTACT
Onset Computer Corporation
www.onsetcomp.com
1-800-564-4377 / 508-759-9500
Fax: 508-759-9100
sales@onsetcomp.com

INDUSTRY NEWS

Press Releases

COMPACT TWIN ROD SERIES PACKS SUPERIOR POWER IN SMALLER FOOTPRINT

Compact Twin Rod Series Packs Superior Power in Smaller Footprint

Wadsworth, OH — The Actuator Division of Parker Hannifin Corporation (NYSE:PH) introduces the new P5TT and P5TD Series Twin Rod Cylinders designed for light-duty, non-rotational and bearing-guided linear motion applications. The series completes the product family of compact, high-speed, short-stroke actuators that provide superior power in a smaller footprint.

Designed specifically for use on conveyor equipment (stops/high-speed rejects), packaging machinery (labeling/positioning/centering functions) and assembly systems (light-duty/high-speed pick-and-place/clamping operations), the new twin rod cylinder series provides cost-effective, leading-edge technology to meet a wide range of application requirements.

With a smaller footprint, the P5TT/P5TD Series Twin Rod Cylinders feature dual-cylinder bores to deliver maximum force in a compact, lightweight package; direct mounting of multiple actuators to optimize cost-effectiveness in multi-axis systems; and unique engineering to provide an economical solution for light-duty, non-rotational functions.

Series standard features include internal bumpers for extend stroke along with adjustable retract bumper stop. A unique T-slot allows for a wide range of mounting options including the ability to mount multiple-axis automated systems directly with no transition plate required. The T-slot also permits integration with all Parker IPS structural aluminum products. The complete series is available in single/dual tooling plate versions.

System porting is designed to enable maximum flow rates to each cylinder bore for high flow rates in high-speed applications, along with increased throughput. Side porting is standard with optional rod porting also available on dual tooling plate models. Stroke adjusters in both directions are standard, while optional shock absorbers provide smooth deceleration even under extreme application conditions.

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The Parker Hannifin Actuator Division combines pneumatic, electro-mechanical, hydraulic and structural aluminum technologies to provide world-class automation system solutions across all industries.

With annual sales exceeding $9 billion, Parker Hannifin is the world's leading diversified manufacturer of motion and control technologies and systems, providing precision-engineered solutions for a wide variety of commercial, mobile, industrial and aerospace markets. The company employs more than 57,000 people in 43 countries around the world. Parker has increased its annual dividends paid to shareholders for 50 consecutive years, among the top five longest-running dividend-increase records in the S&P 500 index. For more information, visit the company's web site at www.parker.com, or its investor information site at www.phstock.com.

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For more information, please contact Alex Rawlings, Marketing Director, AiRTX International, arawlings@airtxinternational.com, 800-307-7475.

JOB MARKET

Job Openings in the Compressed Air Industry

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