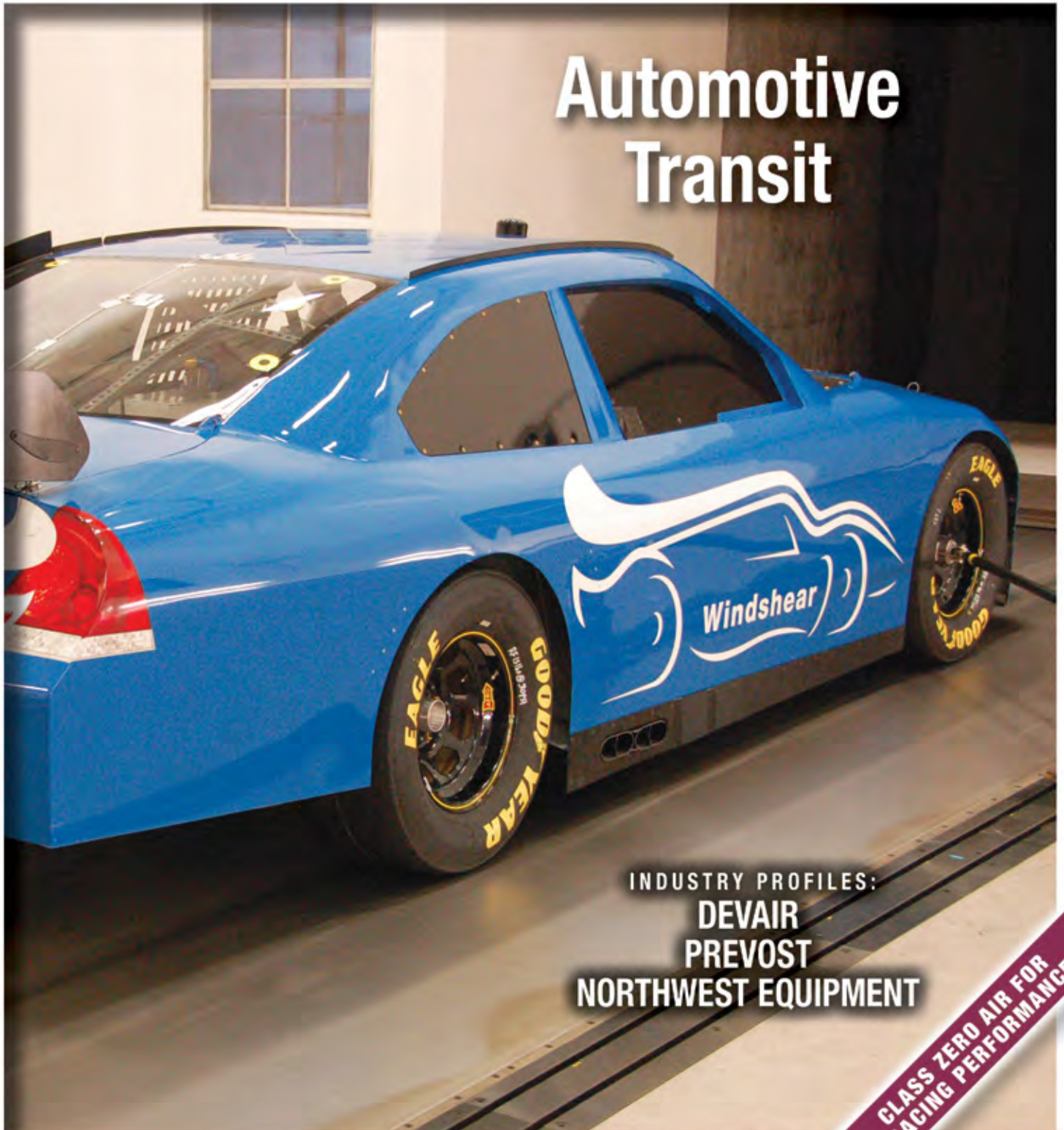


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SE tank mounted rotary screw compressor with dryer, NTF portable nitrogen tire fill system, CA tank mounted duplex compressor



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## FROM THE EDITOR

### Utility Company Energy-Efficiency Incentives for Industry



The model where a utility company provides incentives for industry to invest in energy-efficiency projects can be very effective. There are many examples of both government-run utilities and privately held utilities that do this well. As the United States tries to “be green,” industry is where kW savings can be effectively targeted TODAY. Reducing kW costs in industry provides a “double benefit” in making the business more efficient and better able to compete.

Manitoba Hydro is the government-owned utility in Manitoba, Canada. **Rob Armstrong** and **Ron Marshall** head up the Manitoba Power Smart program, which successfully provides incentives to industry to reduce their energy consumption. In this edition, Ron Marshall shares with us two audit stories this month on projects he did with the bus manufacturers: New Flyer and Motor Coach Industries.

We also have many privately held utilities providing successful energy-efficiency incentive programs. Pacific Gas & Electric, Southern California Edison, Northeast Utilities System and the Southern Company are examples of some major power companies who do this. Some administer their own programs and others contract it out.

Meanwhile, however, we have many of our largest industrial states with little or no incentive programs coming from their utility companies. The utilities in states like Texas, Illinois, Ohio and Pennsylvania are not aggressively pushing industrial energy conservation. Why is this? We hope that by publishing stories about successful audits and incentive programs, more projects will be done and programs created. Thank you for sending us your successful audit stories.

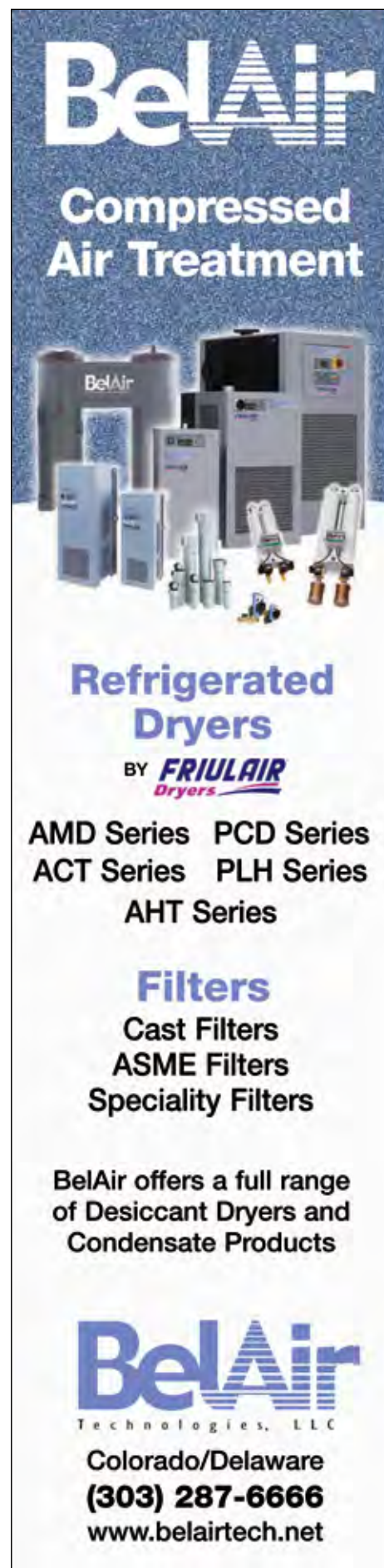
In this edition, it was my pleasure to interview four companies (Mattei, Prevost, Northwest Equipment and Devair). All four firms are privately held and are investing in their growing businesses. I hope you enjoy reading about their optimistic views on the North American market and on their business plans.

Thank you again for your support.

#### ROD SMITH

*Editor*

*rod@airbestpractices.com*



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## UTILITY-AIR NEWS

### Gardner Denver Acquires Best Aire

Gardner Denver announced that it has acquired substantially all of the assets of Best Aire, Inc., a United States distributor of compressed air and gas products, serving the Ohio market through its headquarters in Millbury, Ohio, with additional distribution operations in Kalamazoo, Michigan and Indianapolis, Indiana.



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“Gardner Denver intends to increase its focus on aftermarket sales and service, including adding distribution channels, if necessary, to enhance our ability to better serve our end users worldwide,” said Barry L. Pennypacker, President and Chief Executive Officer of Gardner Denver. “I am very pleased to add Best Aire to Gardner Denver’s compressor operations in North America. This business provides a good base business in Ohio, Indiana and Michigan that will allow for expansion of product lines and aftermarket parts and service to a critical customer base in the Midwestern U.S.”

*For more information, visit [www.gardnerdenver.com](http://www.gardnerdenver.com)*

### Pennsylvania Grant Program for Nitrogen Tire Inflation

The General Assembly of Pennsylvania has passed legislature, which creates a \$100,000 annual nitrogen tire inflation grant program. The grant program will be in effect during the fiscal years of 2008-2009 and 2010-2011. The program may award matching grants of up to 50% of the costs of purchasing and installing a nitrogen tire inflation system to automotive service providers who sell tires in Pennsylvania. Individual grants may not exceed \$5,000 per nitrogen tire inflation system. Reference Senate Bill No. 22 Special Session No. 1 of 2007-2008. Amendment of Act (P.L.1376, No.178)

*For more information, visit [www.legis.state.pa.us](http://www.legis.state.pa.us)*



## UTILITY-AIR NEWS

### Aerzen Announces Green Work Schedule

Aerzen announced a new flexible work schedule that allows employees to commute less and gain more family time. This comes on the coat tails of the inauguration of Aerzen USA's new Green building in April. "The new schedule reflects our commitment to the triple bottom line approach to business," states Jean McAllister, HR Director at Aerzen USA. She is referring to Aerzen's business philosophy of "people, planet and profits." "We have looked at how the work schedule affects our employees (life/work balance), the environment (less commuting = less

pollution) and the finances (cost of gas). Most of the office and production employees are participating in some form of the flexible schedule to contribute to our business approach. The production personnel have had a successful flexible schedule for over a year now," continues McAllister.

Gas prices have brought this type of program to the forefront in the news and many companies are rolling out similar programs. The program includes the majority of the office and production personnel and allows them to choose the days that they would work

a 10-hour day. This means that they have an extra day off during the week. The Green aspect comes into play because it eliminates two car trips during the week.

"I am very excited to see this program come to life," said Hugh Sinn, project manager for Aerzen USA. "We are very environmentally conscious and now I can directly benefit by having more time for myself and less of a carbon impact on the world. I chose to work 10-hour days Monday through Thursday. Then I am off on Friday as well as the weekend."

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### Nazarene Publishing House Enrolls in KCP&L's MPower Program

Nazarene Publishing House (NPH) announced the enrollment of its campus in KCP&L's demand response program, MPower. Nazarene Publishing House, located in Kansas City, MO, has agreed to participate in MPower in order to earn extra revenue for reducing its energy usage just a few times a year.

MPower, which is offered to KCP&L's business customers exclusively through its sole, authorized agent, Energy Curtailment Specialists, Inc., is designed to incent businesses that reduce energy usage on the hottest days of the summer. As an MPower participant, NPH will receive an annual payment from KCP&L in exchange for a reduction in its electricity usage. This program allows KCP&L to manage energy costs and peak summer demand, and defers the need to build another peaking power plant.

"MPower allowed us to review our energy efficiency measures within our campus and save on utility costs," said Pauline Walkenhorst,



The flexible schedule features telecommuting for other employees, McAllister explains, "Some employees drive an hour or more into work. Now, they can choose to telecommute a couple of days a week." In addition to the flexible schedule, other Green aspects of the company are a soon-to-be Gold LEED certified building; an advanced recycling program, an employee with a 100% electric car and carpooling.

For more information, visit [www.aerzenusa.com](http://www.aerzenusa.com)

plant manager for Nazarene Publishing House. "This program has sparked interest amongst our employees and has helped make NPH one step closer to becoming a 'green' company."

In order to make the most of its participation in MPower, when KCP&L calls for a reduction in energy usage, Nazarene Publishing House plans to reduce HVAC and lighting and refrain from using some of the four elevators they have throughout the campus.

"We are excited that Nazarene Publishing House has chosen to participate in MPower," said Brian File, demand response product manager for KCP&L. "We are happy to hear that by participating in MPower, NPH employees are becoming more energy conscious."

For further information, contact Tracey Penner at Energy Curtailment Specialists, tel: 877-711-5453, email: [tpenner@ecsgroup.com](mailto:tpenner@ecsgroup.com) or contact Katie McDonald at KCP&L, tel: 816-556-2365, email: [katie.mcdonald@kcpl.com](mailto:katie.mcdonald@kcpl.com)

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Compressed Air Audit of the Month

# Transit Bus Manufacturing

By Ron Marshall,  
CET, CIM, Manitoba Hydro

## October Audit of the Month

**Where:** Winnipeg, Canada  
**Industry:** Motor Vehicle Manufacturing  
**Issues:** Plant Pressure and Efficiency  
**Audit Type:** Supply and Demand Side

### Financial Summary

**Investment:** \$302,000  
**Energy Cost Before Investment:** \$145,600  
**Energy Cost After Investment:** \$70,600  
**Energy Savings/Year:** \$75,000 electrical  
\$12,000 natural gas  
**Additional benefit:** maintenance cost reduction and reliability  
**Simple Payback (with incentive):** 1.5 years  
**Power Cost/kWh:** \$0.0356  
**Operating Hours/Year:** 8,760

### System Before Audit

**Average Air Flow:** 700 cfm  
**Average power:** 253 kW  
**Specific Power:** 36.2 kW/100 cfm  
**Average Working Pressure:** 117 psi

**Summary of System Before the Audit:** Four plant compressors operating as three independent systems. All four required during normal production time in order to maintain adequate pressure. Air dryers were a mix of desiccant and refrigerated.

### System After Project Implementation:

**Average Air Flow:** 490 cfm  
**Average Power:** 124 kW  
**Specific Power:** 25.3 kW/100 cfm  
**Peak Flow (at electrical peak):** 870 cfm  
**Average Working Pressure:** 105 psi

**Summary of System after the Audit:** One large compressor retired to standby duty. A new VSD compressor added. Compressors run as a combined system. Trim compressors used to supply higher pressure to pressure critical loads on the upstream side of an intermediate controller. Main plant pressure reduced. Dryers converted to cycling style. Heat of compression recovered to heat plant in winter.

## Introduction

New Flyer Industries is a Winnipeg-based heavy-duty bus manufacturer, supplying vehicles to the United States and Canadian markets. The company specializes in vehicles with alternative-fuel drives such as electric trolleys, gasoline-electric and diesel-electric hybrid vehicles; as well as standard diesel buses.

A few years ago, New Flyer's facility manager requested a compressed air system audit to solve a number of issues challenging the plant maintenance and production personnel. The plant was experiencing regular low pressure events that affected painting activities and disrupted the plant production schedule. Maintenance costs were high and system reliability was in need of improvement. New Flyer was also interested in reducing facility energy consumption and was aware that compressed air systems represented a good potential energy reduction opportunity. Their plant equipment was aging and the company was interested in upgrading their air system using the local power utility's financial incentives for energy efficiency upgrades. The utility required a feasibility study be done to qualify.

Manitoba Hydro was retained to do a study of the compressed air system and to recommend improvements. This article discusses the study and some of the results of the completed project.



New Flyer manufactures electric trolleys, alternative-fuel vehicles and standard diesel buses.



### Supply Side Audit

The facility operates as an automotive assembly line with compressed air being required on a 24 hour, 7 day a week (8,760 hours) basis to feed various plant operations. The average electrical rate at this facility is \$0.0259 per kWh with a demand charge of \$7.08 per kVa per month. Based on these rates, the average blended power cost is \$0.0356 per kWh.

Data loggers were placed on the facility compressors for a number of weeks to determine the compressed air energy consumption and to help construct air usage profile. The logging and site observations found that the four existing air compressors were operating as three independent systems. The audit found that the total compressed air energy consumption, including air dryers, was 2,218,000 kWh per year while producing an average of 700 cfm. This calculates to an average system specific power of 36 kW/100 cfm. This benchmark showed that system efficiency was poor and that significant improvement potential existed.

### System 1 — Main System

System 1 supplied the main plant air using one 200 hp modulating compressor (with capacity control) through a fixed cycle desiccant air dryer. A second 150 hp compressor running in modulation mode fed air to the plant during high demand periods. This smaller unit had an associated refrigerated air dryer.



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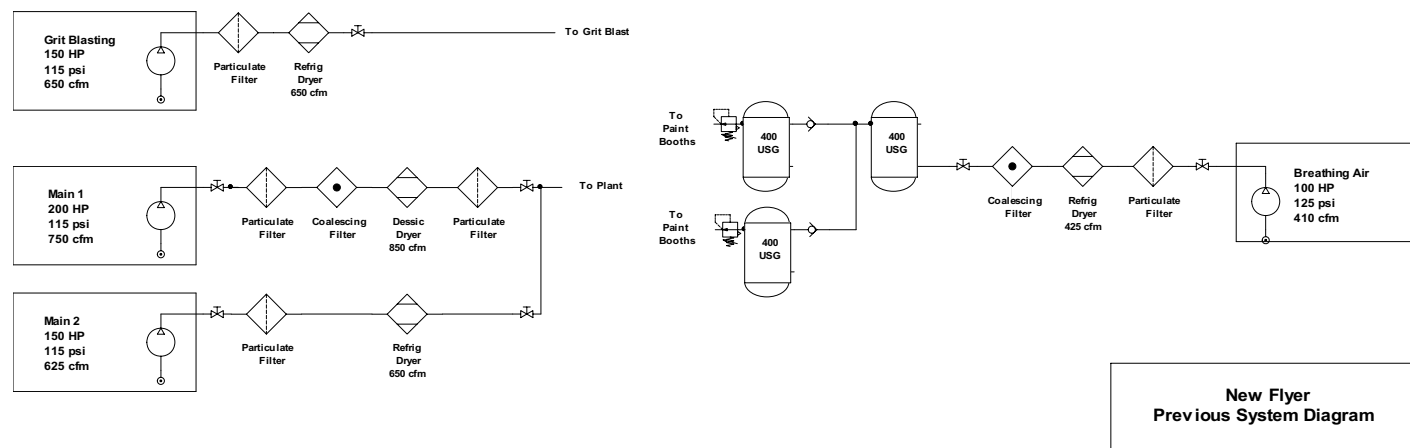
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# COMPRESSED AIR AUDIT OF THE MONTH

## Transit Bus Manufacturing



Monitoring and testing of the supply equipment in this system showed the following issues:

- The 200 hp compressor controls were set up incorrectly. The unit used spiral valve capacity control and inlet modulation to control the output of the compressor, however, the capacity control was not operating correctly, greatly decreasing the efficiency of the unit. The unit was flow tested and was found to be producing 83% of its full load capacity.
- The main system was experiencing low pressure events caused by peak air flows that exceeded the capacity of the two compressors. Plant pressures were dropping below 85 psi which shut down plant equipment and machines.
- The 900 cfm desiccant air dryer was malfunctioning and consuming 220 cfm of air or 25% of its nameplate rating.
- The dryer filters were causing a high pressure differential which prevented the compressors from fully loading during times of high air demand.
- Compressor coordination issues caused the 200 hp unit (the most expensive unit to run) to run constantly, even during lightly loaded evening and weekend shifts. This unit had no automatic blow down control.
- The refrigerated dryer was operating in non-cycling mode causing it to run even when the associated compressor was turned off.

### System 2 — Blasting System

This system consisted of a 150 hp compressor and refrigerated dryer set up an independent supply for a grit blasting operation used to clean bus frames. This compressor was installed with no storage and was operating using inlet modulation control with pressure switch unloading. The unit was equipped with the auto-dual option which is designed to unload and even turn off the compressor during light loads, however, because the system had no storage capacity, the compressor ran constantly, rapid cycling between loaded and unloaded operation even though blasting air was required only 15% of the time. Data loggers showed that this compressor was lightly loaded during times when the main system was starved for air, making it a good potential source of extra capacity during peak flows.



Capacity Controls like this are controlled by a simple screwdriver adjustment. Incorrect adjustment can greatly affect the efficiency of the compressor.



### System 3 — Paint Line and Breathing Air

Due to the pressure problems in the plant, the plant paint lines were split off the main plant system at some time in the past and fed by a separate independent 100 hp load/unload compressor. A 400-gallon storage receiver was installed, but due to its small capacity and a high pressure differential across the system filters and refrigerated air dryer, the unit rapid cycled causing it to consume significant power even though the system was on average lightly loaded at about 20% capacity. Two other check valve protected storage receivers were installed to protect the painting lines against momentary low-pressure events. This was working correctly. This air system was also a potential source of extra air during peak loading.

### End Use Audit

As part of the audit, a review of the various plant compressed air uses was done to determine if there were any opportunities for compressed air demand reduction. This is a time consuming but necessary process that is essentially a thorough point-by-point review of every end use that is connected to the compressed air system. Each use is assessed for possible performance improvements and/or compressed air use reductions. A number of opportunities were found:

- Paint booth filters and compressed air piping were undersized causing excessive pressure drop. This caused the painting operations to be more sensitive than normal to plant pressure fluctuations and forced the plant pressure higher, causing higher compressor energy consumption.



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## COMPRESSED AIR AUDIT OF THE MONTH

### Transit Bus Manufacturing



*Blast nozzle erosion of even 1/16th of an inch can increase the air consumption by 30%.  
A 10 psi plant pressure increase will increase the air consumption by 9%.*



*An engineered nozzle like this is safer, uses less air and is much quieter than a typical pipe style air wand. (Source [www.silvent.com](http://www.silvent.com))*

- Grit blasting nozzle maintenance was less than optimal. Allowing the nozzles to wear excessively before replacement causes higher than desired compressed air consumption, adding to the plant pressure problem at peak flows.
- Open pipe air wands were being used to clean away the blasting media from the bus frames after blasting. These wands were deemed to be a safety hazard as they did not have dead-man switch control, generated excessive noise and wasted compressed air, causing higher than desired peak flows.
- Air winches were being used to move the assembly line. These large air motors were found to use about 10 times the energy of an equivalent electric motor.
- Breathing air purifiers, essentially a desiccant air dryer with a catalytic converter element on the back end to remove any dangerous carbon monoxide from the breathing air supply, were found to be running constantly, even during evenings and weekends when painting operations were not in operation.



### Study Findings

The New Flyer plant had at one time used a single combined system to supply the total plant requirement, however, because very large peak flows demanded by media blasting operations were found to be pulling down the main system pressure, a separate compressor was set aside to feed part of these peak flows in an attempt to protect the main system pressure. Further to this, when air pressure problems continued, the pressure critical painting line was separated off the main system with a new dedicated compressor.

The compressed air audit revealed that separating the systems solved pressure problems in critical localized areas, but the result was the total system ran very inefficiently. In almost all cases, three separate screw compressor systems will consume much more power than one single well-controlled system. This is because each of the three separate systems will now have at least one compressor operating at partial load (a trim compressor). And in air systems with standard fixed speed screw compressors, it is the trim compressors that cause the inefficiency, due to their inherently poor part load efficiency.

Analysis of the flow profile of the plant showed that the original plant pressure problems were likely caused by poor compressor control and the lack of system capacity. Basically, the plant pressure dropped to low levels because the peak plant load (during media blasting) exceeded the



**“This project was very attractive because it fit in with our Corporate goals supporting safety and the environment.”**

— Tino Della Valle, Manager of Facility Engineering and Maintenance, New Flyer

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# COMPRESSED AIR AUDIT OF THE MONTH

## Transit Bus Manufacturing

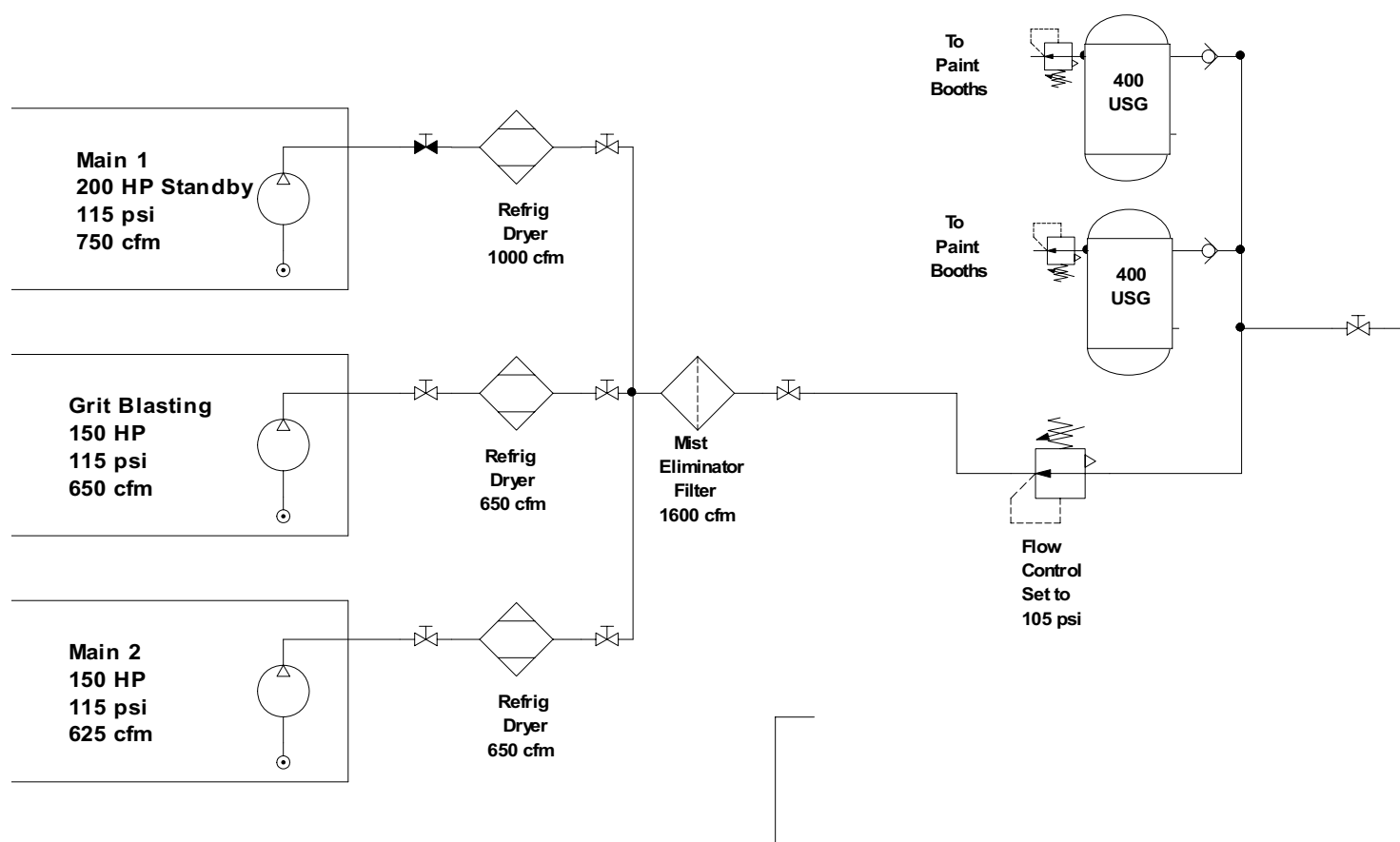
capacity of the existing compressors. With the addition of a single 100 hp VSD compressor, coordination of compressor controls and some load reduction, primarily through elimination of desiccant air dryer purge, pressure reduction and reduction of blowing events, the study showed the three systems could be combined into one well-performing system with enough capacity to handle the full plant peak load with no pressure issues.

### New System

To achieve the proposed savings, New Flyer consolidated their existing air system by combining all of the existing compressors into one single system. The existing 200-hp compressor was retired to standby duty with the intention to run it only on failure of one of the existing units. Once the poorly performing desiccant air dryer was eliminated and the three systems were combined, only 100 hp of extra compressor capacity was required to maintain plant pressure during peaks. This new 100 hp VSD compressor was selected to match an existing 100 hp fixed speed unit and together the two units provide 200 hp of efficient trim capacity pumping into a new 3,000-gallon storage receiver.

Because the paint line requires higher pressure than the main plant, the supply to the line is taken from the high-pressure side of an electronically controlled intermediate controller that regulates the main plant pressure at precisely 105 psi. The base 150 hp compressors have been placed on the downstream side of this intermediate controller, reducing their discharge pressure and lowering power consumption. These units have been set to operate within a single pressure band that brackets the set point of the intermediate controller using a sequencing system internal to the compressor controls.

The new system is performing well with the 200 hp of trim capacity easily and efficiently handling the average plant load. The 150 hp base units are now required only when media blasting occurs, which is about 15% of the time. With the new reduced load and the more efficient compressor operation, the system energy efficiency increased with the combined system consuming an average of 124 kW (including air dryers) while producing an average flow of 490 cfm. This calculates to a more respectable 25 kW per 100 cfm system specific power.





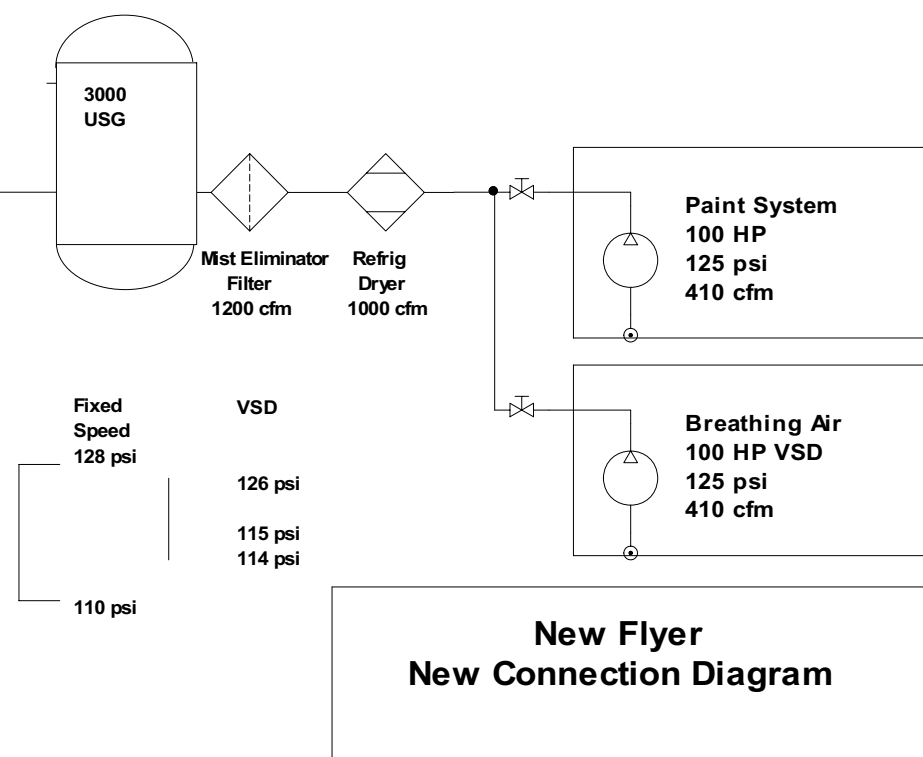
All air dryers have been converted to cycling style, with the refrigeration systems now running only when required, in response to actual dryer moisture loading. Dryer filters have been converted to mist eliminator type with the low pressure differential making compressor control more efficient and reducing the required compressor discharge pressure, which lowers power consumption.

The trim compressors are located internal to the plant which means heat of compression can now be used in winter months to displace natural gas heat. Based on current plant loading, this is saving New Flyer about 36,000 cubic meters of natural gas worth \$12,000 annually at current costs and reducing greenhouse gas emissions.

### Maintenance Reductions and Plant Reliability

Previous to the project, the plant maintenance personnel could not take any one compressor down during the normal production day without risking plant pressure problems. This meant that regular compressor service had to be done during weekends or at night where maintenance costs were a premium. And when disaster happened, and a compressor would fail, production would be affected, necessitating the emergency rental of an expensive diesel compressor.

The new system now has the capacity to provide adequate plant pressure with one compressor out of service. This significantly reduces maintenance costs and decreases the frequency of plant pressure issues.





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## COMPRESSED AIR AUDIT OF THE MONTH

### Transit Bus Manufacturing

#### Utility Incentives

The New Flyer plant is located in an area of North America serviced by Manitoba Hydro, a utility generating electricity primarily using renewable water powered generation. Typical of hydropower producers, the power prices are quite low compared to other areas in North America. This is of great benefit to customers, however, from an energy efficiency point of view — it makes energy projects more difficult to sell based on energy savings alone. Fortunately, Manitoba Hydro was able to provide a substantial financial incentive through their Power Smart® Performance Optimization program. This program was able to provide enough support to bring the project payback to 1.5 years, within the acceptable payback range for management acceptance.

#### Facility Management Speaks

“This project was very attractive because it fit in with our Corporate goals supporting safety and the environment,” says Tino Della Valle, New Flyer’s Manager of Facility Engineering and Maintenance, who was in charge of the air system upgrade, “And our compressed air system downtime is no longer an issue. From the point of view of production, the compressed air system performance is now quite invisible to our users.”

“It’s nice to be able to renew our equipment and get excellent system improvement at the same time, and with Manitoba Hydro helping out with their incentives, it was like purchasing the equipment at a 50% discount.”



## New Flyer Named One of Canada’s Most Earth-Friendly

(TSX:NFI.UN) New Flyer Industries Canada ULC (“New Flyer”), the leading manufacturer of heavy-duty transit vehicles in Canada and the United States has been named as one

of Canada’s most earth-friendly employers for 2008 by the editors of Canada’s Top 100 Employers.

Employers were evaluated based on environmental initiatives that involve employee participation and the degree to which environmental values have been integrated into the corporate culture. Other employers selected for the 2008 list include Fairmont Hotels and Resorts, Hewlett-Packard Canada Co., Toronto Hydro Corporation, HSBC Bank Canada and Toyota Motor Manufacturing Canada, Inc.

“We are pleased to receive this recognition and honored to be named as a recipient in the inaugural year of this award,” said John Marinucci, New Flyer’s President and CEO. “This validates the substantial effort we have put forth in ensuring our pollution prevention and waste reduction activities are successful and embraced by our employees. Not only do we offer the broadest

range of environmentally friendly vehicles of any heavy-duty transit bus manufacturer in Canada and the U.S., we are committed to building these vehicles in a sustainable manner.”

New Flyer operates a Volatile Organic Compound (VOC) reduction program, which is the backbone of its pollution prevention activities, and employee education is a critical component to the success of this program. Since 2002, New Flyer has reduced the amount of VOCs released into the environment by approximately 46%. Employees are also trained on product usage and waste reduction, which has eliminated the use of thousands of liters of paint and the associated waste stream.

New Flyer has been certified to ISO 14001 environmental management standard since 2005. In 2005, the Canadian Council of Ministers of the Environment (CCME) awarded New Flyer the 2005 CCME Pollution Prevention Award. In 2004, CALSTART, North America’s leading advanced transportation organization, awarded New Flyer the Blue Sky Award, which is given for outstanding marketplace contributions to advanced, sustainable transportation.



## Conclusion

This project is an excellent example of how getting to understand the system through an air audit can yield excellent results. Analyzing the system can often find solutions to problems that will reduce energy costs and increase system reliability cut maintenance requirements. Savings and benefits of the project can often be used to justify and pay for equipment renewals. And it shows how utility incentives can help drive projects that may not normally be approved by management. **BP**

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

## Employers for 2008

### About New Flyer

New Flyer is the leading manufacturer of heavy-duty transit buses in the United States and Canada. The Company's three facilities — in Winnipeg, MB, St. Cloud, MN and Crookston, MN — are all ISO 9001, ISO 14001 and OHSAS 18001 certified. With a skilled workforce of over 2,200 employees, New Flyer is a technology leader, offering the broadest product line in the industry, including drive systems powered by clean diesel, LNG, CNG, hydrogen fuel cell and electric trolley as well as energy-efficient gasoline-electric and diesel-electric hybrid vehicles. All products are supported with an industry-leading, comprehensive parts and service network. New Flyer's Income Deposit Securities are traded on the Toronto Stock Exchange under the symbol NFLUN.



# NEW FLYER



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*The Windshear Single-Belt, 180 mph, Rolling-Road in Concord, North Carolina.*



# Class Zero Air

## MEASURES RACE CAR PERFORMANCE

BY COMPRESSED AIR BEST PRACTICES™

A 4,550-pound race car is running at 170 mph and facing wind resistance of 150 mph. The car then enters a curve creating a three-degree “yaw” (the change in angle from the direction the car is headed and the air stream). The car struggles to maintain speed as the yaw changes and the dynamic down force load on the car changes. Suddenly, the driver-less car comes to a stop on the stainless-steel track. The rolling-road track is supported by a cushion of compressed air. The lights dim in the test facility and some engineers review the data on their computers. The test is over and the race team engineers have collected the performance data they needed on their race car. Sensitive compressed air pressure sensors (accurate to  $\pm\frac{1}{4}$  lb.) have played a key role in measuring the performance of the race car. This is the type of race car testing going on at Windshear Inc, in Concord, North Carolina.



## Demand for Data

Windshear Inc. held the formal opening, in July 2008, of North America's first commercially available, single-belt, 180 mph rolling-road wind tunnel facility in Concord, North Carolina. Windshear Business Unit Manager Peter Zierhut said, "Our facility offers highly accurate, repeatable test data previously only available to a select few Formula 1 teams, and never before available anywhere in North America."

Windshear Inc. is an independently operated division of California-based Haas Automation, which also owns and operates the high-profile Haas CNC Racing team. Jacobs Technologies (a division of Jacobs Engineering) staffs and operates the facility. Jacobs Technology specializes in design, construction and operation of wind tunnels for automotive and aerospace industries. In addition, when race teams bring their cars in for testing, they want to know that their performance data will remain confidential. "Security protocols developed by Jacobs Technologies guarantees the security of the data for our clients," said Zierhut.

Race teams are always looking for that extra edge which can mean the difference between victory and defeat. Demand for renting time at the testing facility is reported to be strong with 2008 having been booked for the rest of the year. Demand for 2009 is said to be strong with dozens of customers involved from top-level motor sports organizations in F1, NASCAR, and IndyCar as well as auto manufacturers.

## Compressed Air supports the Rolling Road

The Windshear rolling-road is manufactured by MTS Systems. The Single Belt FlatTrac® Rolling Road is elevated dozens of feet off the ground. The stainless steel track is 10.5 feet wide by 29.5 feet long and 1 mm thick. The track "sits" upon a cushion of 150 psi compressed air. A key piece of technology is in the "revolutionary through-the-belt" sensing system, which directly measures the aerodynamic down force produced by the vehicle.



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## CLASS ZERO AIR MEASURES RACE CAR PERFORMANCE



A series of air bearings keep the track “rotating” on the cushion of compressed air. Nozzles within the air bearings are also able to create an eight-degree angle, which simulates the conditions when taking a turn on the racetrack. Down force is provided by the wind tunnel blowing air on the car. The fan is 22 feet in diameter and is powered by a 5,300 horsepower (hp) motor. The fan is capable of generating winds of over 180 mph.

Extremely sensitive pressure sensors (tolerance of  $\frac{1}{4}$  lb.) are able to measure and record the amount of downforce on the car. The static down force is created by the weight of the car and the dynamic down force is created by the resistance of the wind on the different parts of the car. The pressure sensors can measure this “drag” in various track configurations to see how well the car will perform.



“Windshear told us they would be testing 4,550-lb. race cars, traveling at 180 mph, into a Hurricane Category 4 headwind, and that they wanted their pressure sensors to measure pressure to the accuracy of  $\pm \frac{1}{4}$  lb.” said Jim Bruce, Vice President, Eastern Region at Atlas Copco, who supplied the compressed air system. “We knew right then and there that we had to use Class Zero oil-free air compressors to protect the sensors.”

Left to Right: Carl Cline (Haas CNC Racing) and Jim Bruce (Atlas Copco) with the on-site oil-free rotary screw compressors at Windshear Inc.



### Selecting the Class Zero Oil-Free Air Compressors

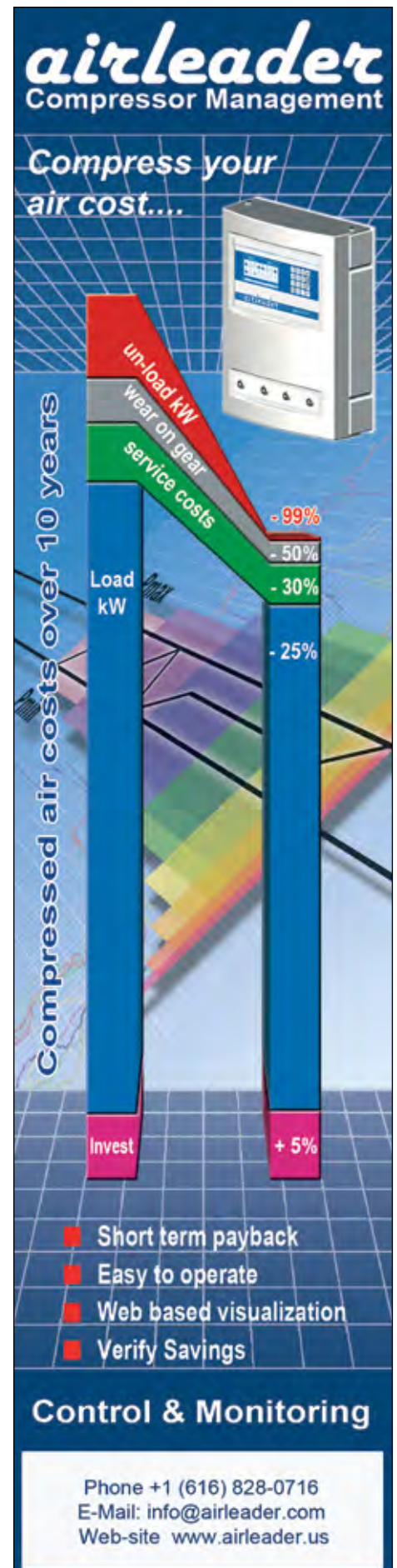
The original specification stated “oil-lubricated compressors could be used if adequate oil removal filtration is provided — including oil vapor removal.” Clinton Gentz, an Atlas Copco Product Sales Manager based in Charlotte said, “We were able to show Windshear and MTS that the integrity (pressure measurement) of the whole Windshear project would depend upon the proper function and maintenance of several air treatment components — if an oil injected screw compressors was used.”

Windshear agreed to eliminate the potential of any compressor oil contamination arriving on the crucial porous carbon air bearings. “They knew it would be costly and devastating and that ISO 8573.1 Class Zero air compressors were the right solution for their process,” said Gentz.

### Oil-Free Rotary Screw vs. Oil-Free Centrifugal Air Compressor

After it was agreed that class zero air was required, the question became whether or not to use an oil-free rotary screw or a centrifugal air compressor. Carl Cline, from Haas CNC Racing, was tasked with purchasing the compressed air system, which would allow the Rolling Road to function, “Atlas Copco offers all the product technologies in question (lubricated screw, oil-free screw and centrifugal compressors). We liked their unbiased product approach in advising us as to what the best system would be for Windshear.” Cline continued, “Our specification calls for 24/7 operation, 365 days a year. We also require that the air compressors provide  $\pm 1$  psi tolerance of air pressure at the demanded air flow regardless of possible extreme temperature and humidity conditions.” It was also made clear that while the design spec called for full load capability during 8,760 hours per year, it was expected to be an application with intermittent demand as the wind tunnel turned on and off during testing procedures.

Dynamic (centrifugal) compressors are greatly affected by ambient and cooling water temperature. The performance of a centrifugal compressor is also diminished when forced to operate above its designed temperature conditions. Therefore, you must design a centrifugal compressor for the hottest expected ambient conditions to ensure adequate flow for the process in the summer months — which is fine until the colder fall and winter months come along. The colder temperatures cause the centrifugal to use more BHP, thus creating more air flow which has to be “blown off” or wasted by venting it to atmosphere. The throttling range or partial load performance of a centrifugal compressor is limited to 15–20% of its full load capacity so when the demand is below the turndown range, the air must be blown off in order to provide a constant delivery pressure.



## CLASS ZERO AIR MEASURES RACE CAR PERFORMANCE



*Left to Right: Clinton Gentz (Atlas Copco), Brian Nelson (Windshear) and Jim Bruce (Atlas Copco) standing underneath the Rolling Road.*

### The Solution

The Atlas Copco Z Series is a positive-displacement, oil-free, rotary-screw air compressor. The installation is made up of two ZT250 air-cooled machines which provide the base-load air. Fluctuations in demand are taken care of by a ZT315 VSD (Variable Speed Drive) air compressor. With positive displacement compressors, brake horsepower (bhp) will remain nearly constant summer to winter. Yet, in the winter, the screw compressor will deliver significantly more mass flow while maintaining bhp nearly constant. In other words, being a positive displacement compressor, the rotary screw compressor's energy is only slightly effected by changes in air temperature. The Variable Speed Drive (with partial load control down to 30% of full load) matched the required demand and efficiently provides constant pressure delivery within  $\pm 1$  psig.



In addition, by offering air cooled air compressors, the installation costs were greatly reduced by not requiring additional cooling water capacity and piping which was very appealing to the Windshear project team and allowed them to size a smaller cooling water system for the overall project. The smaller cooling system provided initial cost savings as well as overall operational cost savings by reducing the required cooling water flow by 250 gallons-per-minute (gpm). The system design specification calls for 8,760 hours of operation per year. This equates to 131.4 million gallons of water saved per year — by choosing an air-cooled air compressor. “We were able to save significant installation dollars by not having to install water cooling systems here at Windshear,” said Tom Eshelman, Compressor Center Manager for Atlas Copco in Winston-Salem.

### Conclusion

Windshear Inc. is open for business and uniquely positioned in the North American market. The compressed air systems are up and running and the Rolling Road measurement systems are working perfectly. Race cars are running at 180 mph and engineers are measuring “yaw” (new vocabulary for me) and its’ effects on the dynamic down force on the car. Quietly and efficiently, compressed air continues to play a key role with new technologies and applications. **BP**

For more information, please contact Compressed Air Best Practices, email: [rod@airbestpractices.com](mailto:rod@airbestpractices.com), [www.airbestpractices.com](http://www.airbestpractices.com)



*Left to Right: Robert and Tom Eshelman (Atlas Copco) supervised the installation and performed the scheduled maintenance on the compressed air system.*

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# AUDIT SAVINGS MOTOR

BY RON MARSHALL, CET, CIM, MANITOBA HYDRO



**Total annual  
electrical savings  
to date are  
an estimated  
1,650,000 kWh.**

A full compressed air audit at Motor Coach Industries in Winnipeg showed that the company's compressed air system was annually costing \$170,000 to operate and maintain. An improvement project, costing \$250,000, has lowered the company's operating and maintenance costs by \$116,000 a year. Payback for the projects is 1.5 years, with the help of a Manitoba Hydro incentive under the Performance Optimization Program.

Motor Coach Industries, headquartered in Schaumburg, Illinois, is the largest manufacturer of intercity tour coaches for the tour, charter, line-haul, scheduled service, commuter transit and conversion markets in the United States and Canada. The company operates a four screw-type air compressor system at its Clarence Avenue plant in Winnipeg. To maintain adequate system pressure at the plant, Motor Coach was forced to run all four compressors 24 hours a day, seven days a week.

## Paint Problem

In the face of high operating costs, the staff tried to control the compressors with timers that often turned the compressors on and off at the wrong times, causing pressure drops during critical operations, such as bus painting. The pressure would drop below the lower limit of 65 psi required by the paint guns, marring paintwork. Oil, water and dust in the compressed air lines would also cause "fisheyes" and other paint defects. Because of detailed customer specifications, reworking a bus paint job can prove extremely costly. On the recommendation of their compressed air service provider, Motor Coach asked Manitoba Hydro to perform an audit to find solutions.



# IN CANADA FOR COACH INDUSTRIES

## Pinpointing Problems

Manitoba Hydro installed data loggers at critical points in the compressed air system to monitor pressure, temperature, current and dew point. Readings recorded by the loggers showed exactly what was happening throughout the system. Pressure drops were caused mainly by incorrect timer settings and manual operation of the compressors.

Another factor was heat build-up in rooms housing the compressors. Temperatures would soar as high as 50 °C, forcing the compressors to shut down. In addition, leak tests with an ultrasonic leak detector identified air leakage serious enough to keep a 125-hp (horsepower) compressor running continuously.

## Recommendations

The audit recommended the following solutions:

- upgrading ventilation in the compressor rooms to prevent overheating of the compressors
- installing heat recovery systems in the compressor rooms so that hot exhaust air could be used to warm parts of the plant during the winter months
- installing an 8,200-gallon receiver tank and flow controller to cushion the compressors from large air events, and keep the minimum number of compressors on line

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## AUDIT SAVINGS IN CANADA FOR MOTOR COACH INDUSTRIES

- running the compressors in efficient load/unload mode, rather than in less efficient modulation mode
- coordinating operation of all four compressors for maximum efficiency
- installing a 2,400-cfm duplex cycling dryer to prevent moisture build-ups in the lines
- installing a high-efficiency, low-differential, coalescing air filter to eliminate oil and other contaminants in the lines
- installing air saver drains that automatically eliminate condensate without losing compressed air
- replacing aging hoses and other sources of air leaks, and introducing a regular system of leak testing

### Seminar Inspires Action

Following the audit, Manitoba Hydro sponsored a compressed air seminar by Scot Foss, world-class expert in compressed air system efficiency. Inspired by ideas from the seminar, Motor Coach staff selected a proposal by a local mechanical contractor to perform a turnkey project that would act on the results of Hydro's audit. Ron Marshall, the Manitoba Hydro Industrial Systems Officer who performed the audit at Motor Coach, reports that to date, the improvement projects have reaped the following savings:

- \$50,000 in lower operating costs
- \$13,000 in reduced maintenance
- \$8,500 in lower gas heating costs through heat recovery

Motor Coach is also saving an estimated \$20,000 a year in increased productivity from improved air quality and system pressure. Total annual electrical savings to date are an estimated 1,650,000 kWh.

"Saving power through increased efficiency was on their management's hit list," says Ron Marshall. "With this project, Motor Coach was able to get a double whammy — excellent power savings and much increased compressed air quality. And they report their equipment runs a lot smoother," he says. "Some say they can even hear the difference when they're out in the plant!" **BP**

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



**"With this project, Motor Coach was able to get a double whammy — excellent power savings and much increased compressed air quality."**

— Ron Marshall, Manitoba Hydro

# HEAVY-DUTY

## AIR COMPRESSORS: DEVAIR, INC.

COMPRESSED AIR BEST PRACTICES™ INTERVIEWED BOGDAN MARKIEL (CEO) AND GARTH GREENOUGH (PRESIDENT) OF DEVAIR, INC.

**Good morning. How is business in Canada?**

Things are holding steady in Canada. Our heavy-duty piston air compressor business is holding up. The rotary screw air compressor products we have launched over the past six years are providing exciting new growth in the United States and Canada. The rotary screw product launches have gone so well, that even though our traditional compressor business is steady, rotary screws make up two-thirds of our shipping backlog!



*A Devair HDI Series reciprocating air compressor ready for shipment.*



## HEAVY-DUTY AIR COMPRESSORS: Devair, Inc.



### Describe Devair's manufacturing capabilities.

We have a 45,000-square-foot facility with 40 employees based here in Barrie, Ontario. The employees range in seniority from six months to 45 years of service. Seventy-five percent (75%) of our employees in the machine shop are veterans with more than 20 years of service. This is the core of our company and compressor technology. In this cell, we machine components for our piston and rotary screw compressor product lines. For the piston compressors, we machine the crankcases, cylinder heads, connecting rods, cylinders and valves, to name some major items.

We have two distinct assembly areas in the facility. One area is assembling piston compressor heads (pumps) and the other is assembling finished product. One of the strengths of our people is their flexibility — we do a lot of cross training and as a result, people are skilled at operating in different cells. This flexibility has allowed Devair to train our people on how to assemble many different products.

Other work cells include our electronic control panel assembly and a paint shop for the receiver tanks.

### Can you share some of Devair's history and culture with us?

The roots of Devair go back to the early 1900s when we were a part of the DeVilbiss Company of Toledo. DeVilbiss formed an industrial air compressor division and moved it, in 1954, to Barrie, Ontario. This is why



*Seventy-five percent of the employees in the machine shop are skilled veterans with more than 20 years of experience.*

we have so many veteran employees with decades of expertise. Devair, Inc. was formed in 1998 as a stand-alone business and we are the two majority shareholders.

Our main focus is on building rugged, reliable, heavy-duty air compressors. Our heavy-duty industrial (HDI Series) pressure lubricated air compressor has been our flagship product line for many years. Devair's tradition is imbedded in using durable materials for the pumps (like best quality American-made grey iron) and precision-machined components produced by our veteran workforce. Our culture is all about supplying reliable, heavy-duty, high-quality products to our customers.

### What are the benefits of buying a piston air compressor?

We supply both rotary screw and piston compressor technologies so we are in the position of showing a customer his options. Each factory/shop is unique and there is no standard answer to this question. Piston compressors are still a far better choice for some end users.

The cost of maintenance, of a high-quality piston compressor, is only 25% of the cost of maintaining a rotary screw air compressor. Devair piston compressors run at a very slow speed of only 590 rpm — so there is very little wear on the lubricant and the machines run very cool. There is no oil-separator filter element to change and pistons use standard mineral oil as a lubricant — which costs much less than the synthetic oils that rotary screw compressors use.

Most important is that customers remember to consider only heavy-duty, high-quality piston air compressors. There are many piston compressor designs out there that are not designed for industrial use. These designs have very short life cycles and produce low air volume.



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## HEAVY-DUTY AIR COMPRESSORS: DEVAIR, INC.



*A tank-mounted rotary screw compressor with dryer package ready for shipment.*

### When should one buy a rotary screw compressor?

Again each customer will have unique circumstances and priorities. Rotary screw compressors can be more efficient than piston compressors in installations where air demand is pretty constant. A 24-hour operation, which is racking up 8,000+ hours, is ideal for capturing the energy efficiencies of rotary screw compressors. Recently we have added the DVS series of variable speed rotary compressors to address the needs of customers demanding flexible air volume supply and energy savings.

The sound attenuation possible with rotary screws is also desirable to some customers. We designed Devair rotary screw air compressor sound attenuation packages working together with Canada's National Research Council. The results have been very worthwhile as we have some models with 63 dba sound levels!

Rotary screw compressors are also delivered with PLC controls which allows end users the ability to monitor and manage the air compressor from a remote location.

### What industries does Devair focus on?

Devair products are strong with most applications in medium to small industry. We work with a lot of body shops in automotive refinishing and also with automotive mechanical service. Our products are popular in woodworking shops, building materials and HVAC — to name a few more applications.

### What's happening with the new waterborne regulations?

The demand for compressed air has been increased with waterborne regulations. Water-based paints require increased air flow to cure when compared with solvent based products, typically bodyshops invest in spraybooths equipped to reduce drying time of waterbased paint and add air guns to dry smaller refinished areas. Each air gun (one nozzle) uses 7 to 13 cfm of air, depending on the number of bays equipped with these guns demand for compressed air can increase significantly.



The compressed air must also be dry and clean. We recommend industrial refrigerated air dryers and coalescing filters to purify the air. Many body shops have used air treatment products with limited life cycles and the air quality has been mediocre at best. This is no longer acceptable with the waterborne paints.

### How does Devair go to market?

We sell our products through a network of very loyal distributors. We don't sell direct. We see distributors as an integral partner in serving the end user. The distributor is whom the customer relies on for service and support. We offer service training for distributors on a regular basis and average one multi-day class every two months for service technicians.

Across Canada we have a very strong distributor network and good market saturation. In the U.S., we have areas, which are stronger than others and have area managers who are working to develop new distributors in the U.S. We also sell in France, Mexico, the Middle East, the Caribbean and many other countries. We have a lot of growth opportunities and we must prioritize them. Our priority right now is to further develop distributor partnerships in the U.S. **BP**

### Thank you, Devair, for your insights.

For more information, please contact Bogdan Markiel, Devair, tel: 705-728-5657, email: bmarkiel@dvair.ca, www.dvair.ca



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# Investing in MATTEI COMPRESSORS

COMPRESSED AIR BEST PRACTICES™ SPOKE WITH JAY HEDGES (GENERAL MANAGER) OF MATTEI COMPRESSORS.

## Good morning. How is business at Mattei Compressors?

Good morning. This is a very exciting new chapter for Mattei. The Company has entered into the third phase of significant investments into Mattei. The first two phases of investments focused on optimizing Mattei rotary vane technology for enhanced energy efficiency and then taking them to market in Europe. This has been very successful.

The objective of “Phase 3 Investments” is to bring these newly optimized rotary vane technologies to market in North America. On average, our new rotary vane designs are 10% more efficient than rotary screw air compressors. This performance exists across the board at all load profiles. Durability is also extremely high because these air compressors run at low speeds between 1,200–1,800 rpm.

## How energy efficient are the new rotary vane air compressors?

Our research and development group in Italy is led by General Manager, Mr. Giulio Contaldi, the son of Mattei's Founder. Mr. Contaldi's team has focused on optimizing the energy efficiency of rotary vane air compressors and they developed several breakthroughs. The first approach was to find the optimal running speed (from an energy efficiency standpoint) for each product series. The solution was to design a unique air end and motor set for each air compressor model. In this way, each model provides maximum energy efficiency. In Mr. Contaldi's words, “We are in a unique situation in which



*Mattei manufactures a full range of rotary vane air compressors.*



# Efficiency

no one has ever taken the study of the vane technology to our levels and this has left loads of space for improvement (which we will gladly take advantage of). On the other hand, screw compressor manufacturers have in the past 20 years invested substantial amounts of money in universities and R&D departments all over the world and have developed their compressor to its physical limits. Therefore, I believe that screw technology is fast approaching its zenith in performance betterment."

The R&D team set the standard running speed at 1,800 rpm — with the ability to run at speeds as low as 1,200 rpm. The slower the unit runs, the less specific energy it consumes. The Maxima Series (a constant speed machine) is a single-stage air compressor with a performance curve similar to that of a two-stage air compressor. Mattei is delivering six scfm per horsepower (hp) with the single-stage Maxima! We turn the Maxima airends at 1,200 rpm to deliver the best kW/100 scfm performance in the industry. All Mattei air compressors feature direct-driven in-line airends. This eliminates drive train efficiency losses associated with belts or speed increasing gearboxes. The result is superior performance and the highest possible efficiency.

## What advantages do rotary vanes offer vs. rotary screw compressors?

Rotary vane air compressors produce more air per revolution than rotary screws — the Maxima, operating at 1,200 rpm achieves optimum efficiency. By comparison, most rotary screws are running at 3,500 to 7,000 rpm, increasing wear and reducing air end life. There are many inherent design advantages in the rotary vane:

- Produce more air per revolution with some models producing six scfm per hp!
- Larger compression chamber offers more space, and therefore more volume of air to compress per revolution.
- Achieves 90% mechanical efficiency due to better internal sealing. Design eliminates the efficiency robbing of internal blow-holes found in rotary screws.
- Greater durability due to low operating speeds; Mattei airends rotate on two bushings and are designed to be 100,000-hour machines.
- Screw air ends run fast, use up to six bearings and tend to last about 35,000–40,000 hours. By eliminating air end bearings, Mattei has eliminated one of the most common scheduled failures found in rotary screw airends.

Save

and




### Prevost ALR Aluminum Air Piping:

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- Energy efficient...** Smooth passages & leak free connections for life-long energy savings.
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## INVESTING IN EFFICIENCY: MATTEI COMPRESSORS



General Manager Jay Hedges examines new 100 series automotive compressor to be launched in Europe this fall and in the United States in 2009.

### Please discuss the durability of rotary vane technology.

Known as 100,000-hour machines, Mattei rotary vane compressors are often chosen for OEM applications because of their durability and their compact size. The Optima Variable Speed Series, with 11 kW to 132 kW models, has a speed range of 700 to 1,800 rpm. Durability is greatly enhanced by low-speed machines and “bearing-less” air ends. Proper maintenance and service is important to the rotary vane as it is with any compressor, but with proper maintenance, you are much less likely to see unscheduled downtime with Mattei Rotary Vanes than with rotary screws. We will demonstrate our confidence in these new products when Mattei’s new Worldwide Warranty Program is announced at our bi-annual Distributor Convention in Milan, October 16th through 19th, 2008. I am thrilled to be leading a delegation of 23 individuals representing the U.S. market this year.

### Can you provide us with an overview of Mattei’s product line-up?

Sure. Aside from some niche products for OEM’s and other technologies in R&D, we offer four distinct product lines for sale. They are the:

1. ERC Series (2–100 hp): These are open-frame, fixed speed, rotary vane compressors that are amazingly quiet, feature simple controls and offer economy and extraordinary reliability and performance.
2. AC Series (5–60 hp): This is the next level of sophistication featuring quiet cabinets, electronic controller, soft Wye-Delta motor starter and optional integrated refrigerated air dryer.
3. OPTIMA Series (11–132 kW): Cabinet enclosed featuring VSD controllers to optimize energy savings for facilities with varying levels of plant air demand. Optional integrated air dryer and condensate management system.
4. MAXIMA Series (40–150 hp): Quiet ( $\leq 70$  dBA) cabinet enclosed, runs at an incredibly slow 1,200 rpm to offer maximum energy efficiency (as low as 14.48 kW/100 scfm) for systems with high levels of demand. Optional integrated air dryer, condensate management and heat recovery system.



### Please describe Mattei as a company.

Mattei was founded, in 1919 in Italy, so next year we will celebrate our 90th anniversary! Our headquarters and primary manufacturing center is in Vimodrone, Milan. Assembly of air compressors above 30 kW is done in Vimodrone. Smaller-sized, high-volume production compressor assembly is done 30 km away, near Bergamo. Bergamo also manufactures air end components in our state-of-the-art machining centers and operates MTA, a separate company charged with providing genuine parts for Mattei compressors worldwide.

The company was purchased, in the 1960s, by the Contaldi family. The Contaldi family has owned and operated industrial businesses since 1886. In addition to Giulio Contaldi mentioned above, sister Silvia Contaldi heads up Sales and Marketing activities as Commercial Director, and their mother Carla Contaldi succeeded her husband as Chairman and CEO, providing ownership and management continuity.

Mattei employs approximately 250 people worldwide. We operate multiple subsidiaries across the world including 50 employees in Russia and approaching 20 employees at a rapidly growing 100% wholly owned assembly operation in China.



*From left to right: The Contaldi Family: Giulio Contaldi (Director of R&D and Manufacturing), Carla Contaldi (CEO) and Silvia Contaldi (Director of Sales & Marketing).*

### How does this affect how Mattei does business with distributors?

The business is very personal to us. The Contaldi family works day-to-day with product development, international expansion and the overall management of the business. Their hands-on style has focused on optimizing rotary vane technology with strong results and fostered long-term personal relationships with distributors worldwide.

The compressed air world is primarily made up of multi-brand multinationals who have acquired many independent brands. A distributor who has spent a lifetime building a business selling a specific brand, is often dealt unpleasant news after an acquisition. Mattei remains committed internationally to distributors as its' sales channel.

### What is the setup for North America?

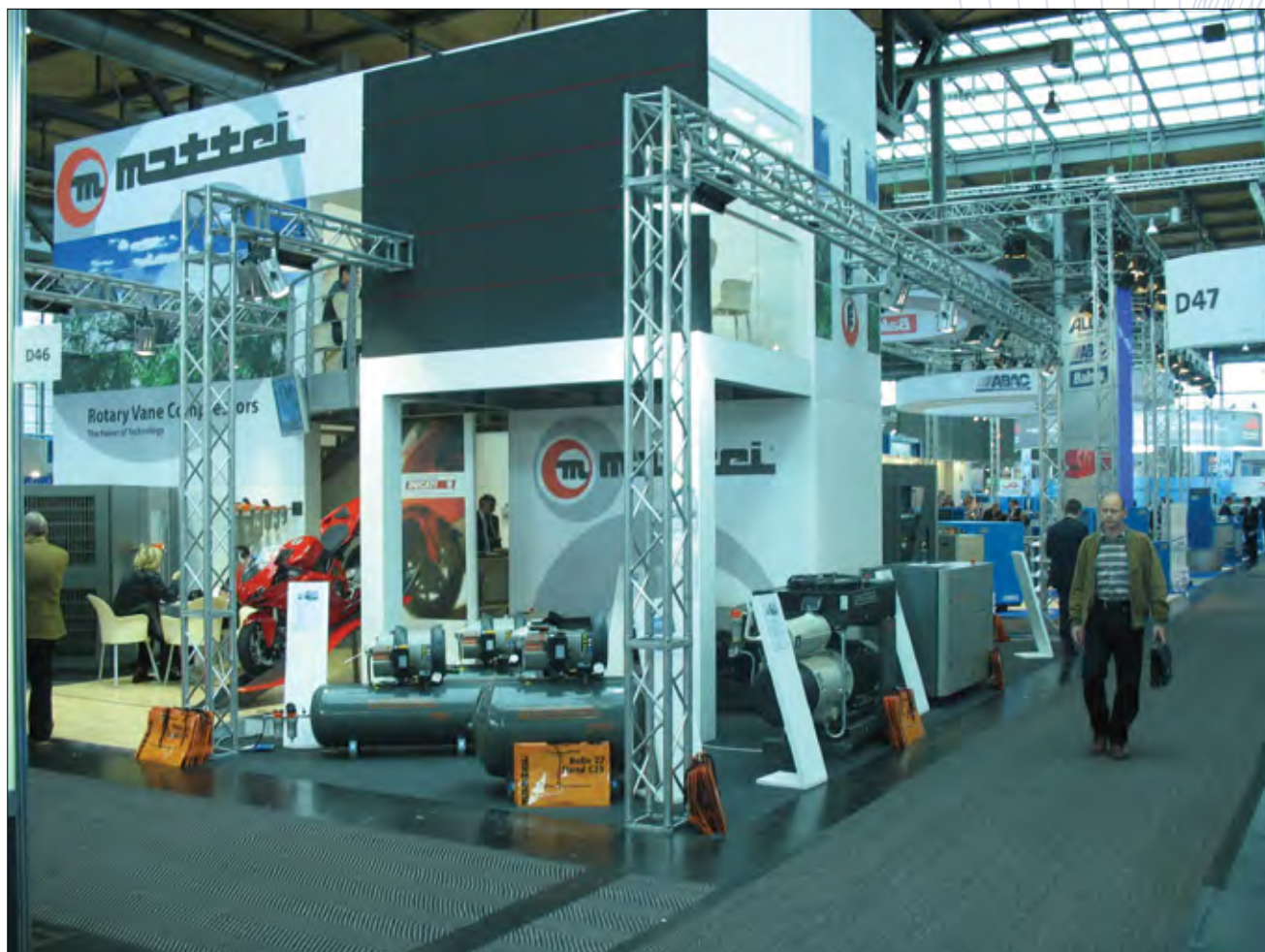
Mattei has been operating in the U.S. for 27 years. We continue to be headquartered near Baltimore, Maryland where we will continue to assemble the open-frame ERC machines. The big change will be our plan to stock air compressor models of up to 132 kw including Maxima, Optima and AC machines. These machines will arrive "ready-to-ship" from Italy and allow us to have inventory available for fast deliveries.

---

**“Mattei is  
delivering  
six scfm per  
horsepower (hp)  
with the  
single-stage  
Maxima!”**

---

## INVESTING IN EFFICIENCY: MATTEI COMPRESSORS



*Mattei Compressors will be exhibiting again at Hanover in 2009.*

### What are the plans in the U.S.?

We will first increase the brand awareness here by leveraging Mattei's Global reputation for quality and innovation, through a focused marketing strategy including, trade advertising, trade shows, direct mail, sales contests and other promotional campaigns. It doesn't take much to stand out in industrial advertising so a little creativity goes a long way. We are building a state-of-the-art training center and a show room in Baltimore, which will support our distributor growth strategy by demonstrating our products and conducting service training schools.

Our sales strategy is to support existing loyal distributors while expanding distribution geographically. We are strong on both coasts, with our largest distributors based in Los Angeles and New Jersey. We have many opportunities for distribution in the Midwest and South.

Having recently signed four of the top sales rep companies in the U.S., Mattei now has 23 individuals in the field supporting and building our distributor network. The quality of these companies and the distributor prospects we are working with is a clear indication of the remarkable performance of the new Mattei air compressor products just now arriving in the U.S. Educating the marketplace is our greatest challenge. Once distributors and their customers see these compressors and the performance data, the rest is pretty easy. Our objective is to educate as many as possible through various marketing and sales programs. **BP**

### Thank you, Mattei, for your insights.

*For more information, please contact Jay Hedges, Mattei Compressors, tel: 410-521-7020, email: [jhedges@matteicomp.com](mailto:jhedges@matteicomp.com), [www.matteicomp.com](http://www.matteicomp.com)*





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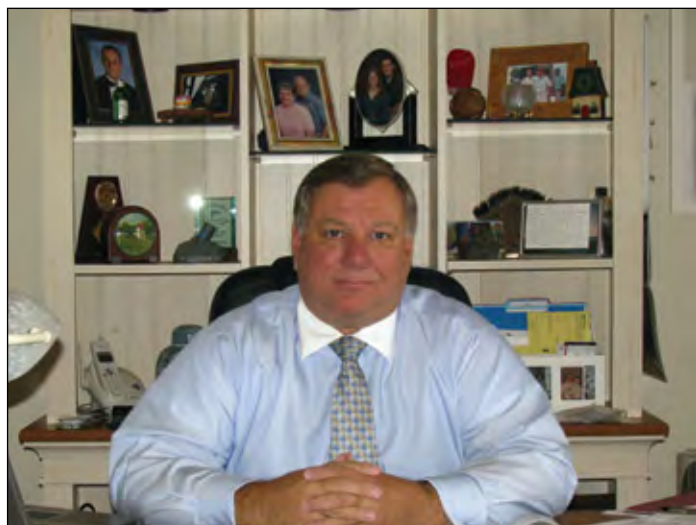
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trade association

# ALUMINUM PIPE SYSTEMS:

## PREVOST CORPORATION

COMPRESSED AIR BEST PRACTICES™ INTERVIEWED MARK MCKEAN  
(NATIONAL SALES MANAGER) FROM PREVOST CORPORATION.



*Mark McKean of Prevost Corporation.*

### **Good Morning. Can you give us some information on your background?**

Good morning. Sure, I grew up in Connecticut, graduated from Embry-Riddle Aeronautical University and went to work for Cessna Aircraft selling airplanes. In the 1980s, I made a decision to move into the industrial marketplace as a manufacturer's representative. In 1997, I went to work for Legris and was fortunate to help bring their innovative Transair aluminum air piping system to market over the next seven years. In 2004, I joined Prevost Corporation and now have full sales and marketing responsibility for the United States and Canada.

### **Can you give us some information about Prevost?**

Prevost was established in 1978 with the vision of developing an innovative, new style air coupling. The result was the world's first push-button quick-disconnect coupling. A few years later, Prevost developed a venting-action, push-button, quick-disconnect coupling that became the first safety coupling to pass the ISO 4414 safety standard.





Today, Prevest has built a large range of product offerings — in addition to the push-button couplers. Prevest supplies Aluminum Air pipe systems (called ALR), OSHA-compliant ergonomic blowguns, FRLs (filter-regulator-lubricator assemblies) and a large range of hose reels and accessories. We recently won the Innovation award for our Safety Air Fuse, which protects against injury or damage from a sudden break in a compressed air line. These products have become the connections of choice for pneumatic tools and air hoses among professional mechanics and technicians throughout the world.

*Prevest Global Headquarters in Annecy, France.*

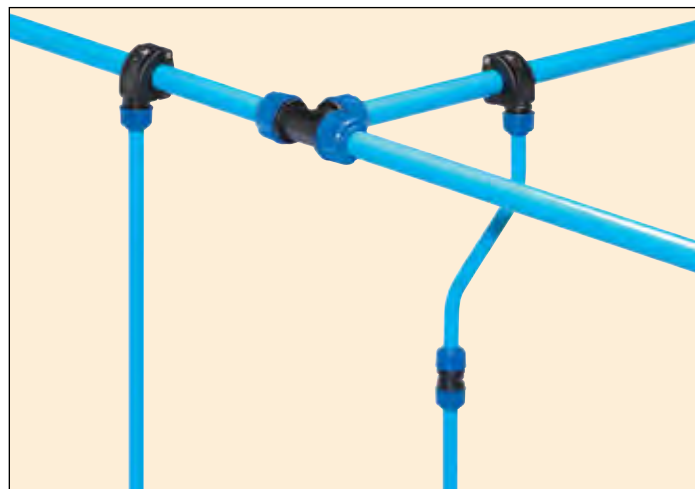
Prevest is truly a global company. Our headquarters is located in Annecy, France. We have sales managers located throughout Europe and other strategic locations worldwide. Our North American Headquarters is in Greenville, South Carolina.

### **How does Prevest take their products to market?**

Prevest has an extensive network of distributors located throughout North America. In the beginning, our focus was heavily influenced by the automotive market. During the past several years we have been moving into industrial markets. Our primary sales channel to the industrial market is with many air compressor distributors who have created opportunities in large manufacturing facilities. We are not limited by industry type, in fact Prevest can be found in almost every industry.

### **Let's talk about aluminum pipe systems.**

It has always amazed me that a company will pay thousands of dollars for an efficient compressor only to neglect the rest of the air system. Compressed air is expensive and an air system should be efficient from the compressor all the way to the air tool or machine. Have you ever



*An aluminum piping system for compressed air.*

## ALUMINUM PIPE SYSTEMS: PREVOST CORPORATION

### A Cost Comparison Between Piping Systems

This is an installation cost comparison between black iron, copper and aluminum piping systems. The system compared consists of a 300-foot looped header using 1" pipe. The total of 1" pipe compared is 340 feet. There are six ½" pipe drops — each being 10 feet long and connected to a double ported outlet.

Proper piping practice used so that condensate does not directly flow down a drop. In the case of black iron and copper, a reducing tee, and two 90-degree elbows are used to create the swan neck. Prevost aluminum pipe uses a single tapping saddle with a built-in condensate retention device.

Labor hour estimates for the installation were obtained from the MCAA Labor Manual as follows: aluminum — 20 hours, black iron — 63 hours, copper — 74 hours. All labor was figured at \$65 per hour. Please note that the cost comparison does not include pipe hangers and threaded rod, as all pipe systems must be hung in the same fashion. Material costs are approximate and are close to list price.

PIPING SYSTEM	WEIGHT*	MATERIAL COST	LABOR COST	TOTAL COST
Aluminum	4 lbs.	\$1,822	\$1,300	\$3,122
Black Iron	35 lbs.	\$1,196	\$4,095	\$5,291
Copper	18 lbs.	\$2,080	\$4,810	\$6,890

\*Weight is for a 21-foot section of pipe (aluminum was 19.7 foot)

been in a plant on a day when there is no activity? Listen to the sound of air leaks, that's the sound of wasted energy, which is wasted dollars. Prevost offers a complete solution from the outlet of the compressor to the tool. We call it "The Perfect Shop."

I am as passionate about this product today as I was 10 years ago. The popularity of aluminum air piping has grown substantially year after year — and I see no end in sight. The market was clearly ready for a new product. In the beginning it was difficult to gain acceptance after years of black iron and copper systems and even plenty of PVC pipe. The distributors who took the risk back then to introduce aluminum pipe systems have been rewarded many times over.

### What was the spark that ignited the growth of aluminum pipe systems?

I think the spark was and continues to be the education provided by the Compressed Air and Gas Institute (CAGI), air audits, magazines like Compressed Air Best Practices™ and the Compressed Air Challenge®. Education has encouraged companies to look at a systems approach to optimizing compressed air operations. This was a huge change from traditional concepts of "adding another compressor" to solve air delivery problems. Generating and maintaining compressed air is typically a company's second largest energy expense. An efficient air system can pay for itself in less than two years. A good system can also resist corrosion, scale and other debris that damage and reduces the life of expensive components and tools.

### What are some of the disadvantages of traditional pipe materials?

Black iron pipe and galvanized pipe have been around forever. The cost of black iron material has increased and over the life of a shop, black iron will cost the owner more due to problems associated with corrosion and leaks. Leaks created due to corrosion can occur as quickly as six months after installation. Corrosion causes a reduction in air pressure thereby increasing energy consumption. Black iron pipe is also heavy requiring several people to install and requires threading machines which creates a mess with cutting fluids and debris.

Copper pipe provides excellent resistance to corrosion, but the material cost of copper has risen sharply over the last two years. It also requires open flame, skilled labor and extensive labor hours to install. There are no built-in condensate prevention devices so a swan neck needs



to be sweated in to provide for optimal use. Manifolds are usually crude at best with 90-degree outlets causing the hose to bend sharply — substantially reducing the life of the hose.

Plastic pipe is being used less and less. Poorly designed systems have literally exploded. That's an obvious safety hazard. Some compressor lubricants can deteriorate pipe glues and cause joint failure. The Plastic Pipe Institute (PPI) recommends against using PVC in exposed compressed air systems. The Department of Labor and Industries warned consumers and employers in May 1988 that plastic-polyvinyl-chloride (PVC) pipe cannot be used in compressed air piping systems without risk of explosion. By law, employers must protect their workers by avoiding the use of unapproved PVC pipe in such systems.

### What are the advantages of aluminum air pipe?

Aluminum offers excellent resistance to corrosion, lower air friction and offer a full-flow design with no restrictions caused by fittings. Aluminum pipe is lightweight, easy to install and requires no open flames, threading machinery or special tools. Adding a drop is a simple operation. Aluminum can be installed by plant personnel in a fraction of the time it takes to install Black Iron or copper and can be easily modified or moved to another location. All of this translates into lower initial costs when you factor in installation, and a safer, cleaner and efficient system.

### Are there other considerations to keep in mind when designing an air piping system?

Absolutely. Be sure your system is properly sized to supply your anticipated air volume demand during peak operation. Plan your system for possible future shop expansion. Here are some tips for a safe and efficient system.

**Sizing:** Properly size all piping components from the ring-main to each drop. A looped ring-main with a minimum amount of elbows is the most efficient system. Looping the system can cut your pressure drop in half while providing built-in storage for your compressed air. Be sure the pipe is installed with adequate supports to ensure optimum efficiency and safety.

**Air Treatment:** Don't skimp here! Make sure your piping system has air treatment components like condensate control, filtration, lubrication (never use lubricators where you will be using compressed air for painting), drains and pressure regulators.



*A Filter-Regulator-Lubricator (FRL).*

## ALUMINUM PIPE SYSTEMS: PREVOST CORPORATION

### What safety features can air connections and hose assemblies have?

Often overlooked, air connections and hose assemblies can dramatically affect safety, productivity and reduce utility costs from leaks. Selecting “bubble tight” or “leak free” compressed air products is important. One leaky coupler can cost hundreds of dollars in utility costs each year. Multiply that by the number of connections in your plant, and you can see how investing a little more up front can save you thousands in the long run. Here are some of my recommendations:

**Quick Couplings:** Specify “venting action” safety quick-couplers at the air source or manifold. This simple choice eliminates “hose whip” reducing personal injuries and damage to equipment or vehicles. “Hose whip” occurs when disconnecting a pressurized air hose. Impact-resistant composite quick couplings with a quick push-button release can make one-handed disconnection much easier than a conventional metal sleeve type.

**Specify “bubble tight” push-button non-scratch couplers for use at the air tool.** Use HVLP (high volume low pressure) couplers for use in painting areas. This coupler will provide better air flow to the paint gun as well as extend the life of an air tool.

**Hose assemblies:** In areas where there is a lot of traffic or activity, select self-coiling hoses or retracting hose reels to keep air hoses out from underfoot and provide a safe, efficient work area.

### Some final thoughts on Aluminum Pipe Systems?

Aluminum pipe systems are here to stay. The growth we have seen in the last 10 years has been very impressive. There are thousands of installations worldwide in almost every industry. Companies have begun to take a serious look at Return on Investment (ROI), and with energy costs rising; it only makes sense that your compressed air system be optimized. Adding a compressor which is efficient is only the beginning. The best compressor in the world will keep on running to service air leaks and poorly designed pipe systems. The answer is to complete the optimization by using bubble tight components and good piping practices. The future will bring new and exciting technology and the days of black iron pipe are gone with the Ford Model T. **BP**

### Thank you, Prevost, for your insights.

For more information, please contact Mark McKean, Prevost Corporation, email: [m.mckean@prevostusa.com](mailto:m.mckean@prevostusa.com), tel: 800-845-7220, [www.prevostusa.com](http://www.prevostusa.com)

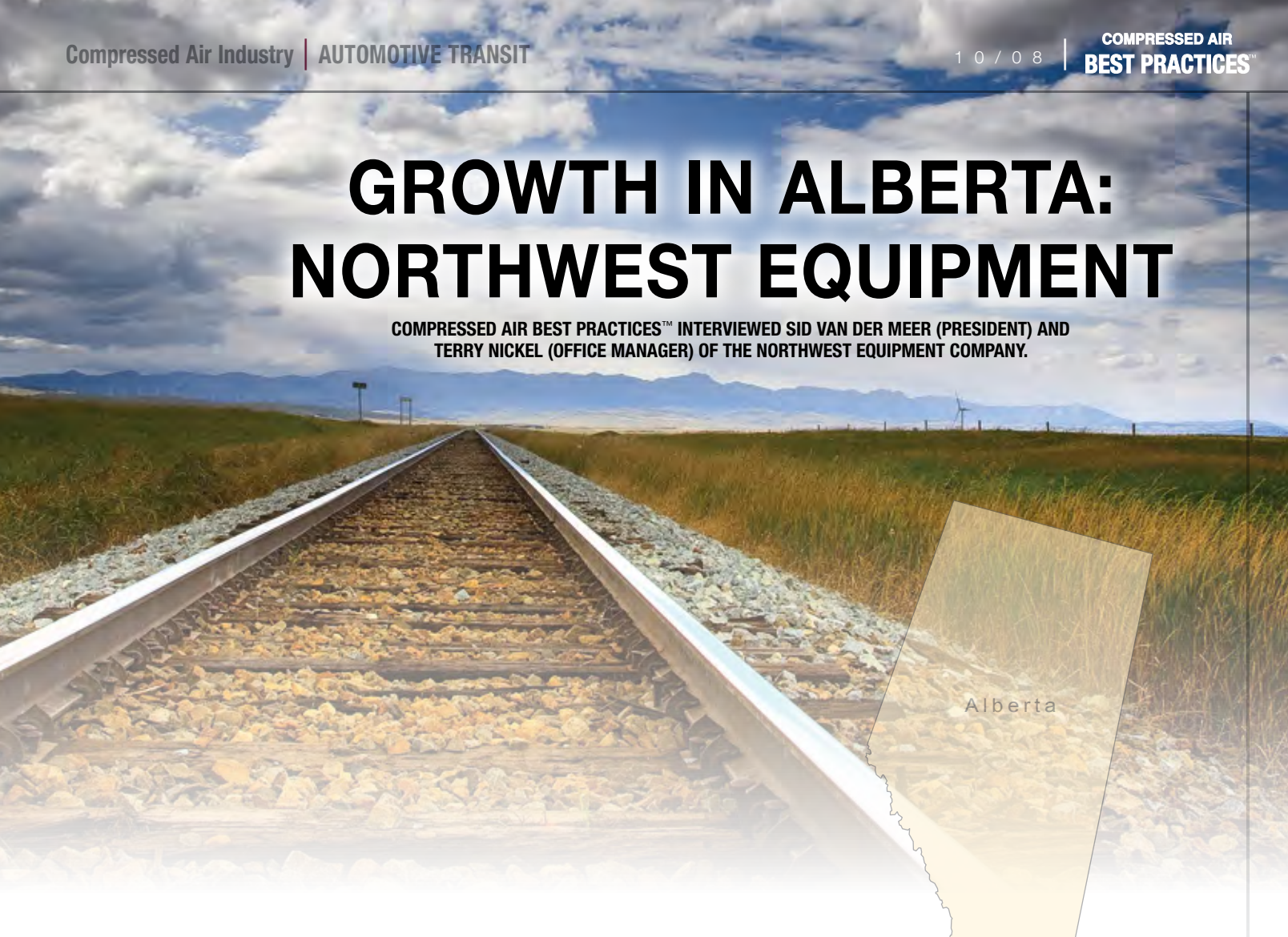


*Increase safety by selecting the proper air connections and hose assemblies.*



# GROWTH IN ALBERTA: NORTHWEST EQUIPMENT

COMPRESSED AIR BEST PRACTICES™ INTERVIEWED SID VAN DER MEER (PRESIDENT) AND TERRY NICKEL (OFFICE MANAGER) OF THE NORTHWEST EQUIPMENT COMPANY.



Alberta

## Good morning. How is business in Western Canada?

Good morning! Business is very strong in both the oil exploration market and with standard industry here. Alberta has the second largest oil reserves in the world — when you include the tar sands. We have over 90,000 Americans living in Calgary due to the oil industry. All major oil exploration companies and engineering firms have offices in Calgary. The fact that these engineering centers are located here has also allowed Northwest Equipment to get involved with a significant amount of packaging for international projects.

The “rooftop” industrial market is also growing due to the rising cost of electricity here. The energy industry was deregulated at the beginning of 1996 and electricity costs for industry have risen since then from two cents per kwh to nine cents per kwh! This has created an environment where industry is looking for ways to reduce energy costs.



*Jim Wood, Patti Van der Meer and Sid Van der Meer (owners) of Northwest Equipment.*



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

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## GROWTH IN ALBERTA: NORTHWEST EQUIPMENT



Northwest Equipment Headquarters in Airdrie, Alberta.



A Turn key Compressed Air Building leaves for the oil fields.

### How was Northwest Equipment started?

In June of 2000, two partners and I (Mr. Van der Meer) started Northwest Equipment here in Alberta. We were a total of four people and had our offices in Calgary. In 2003, we acquired the Compressed Air Division of Britannia Compressor Sales. I had been a sales person and partner at Britannia from 1979 to 1997. Britannia wanted to focus on the oil drilling business and we are 100% focused on compressed air systems. The acquisition was good for both companies.

Our slogan is "Total Compressed Air Solutions." We prefer the customer give us their application and then we will find the best solution for them. This philosophy has worked well for us. Northwest Equipment grew 30% per year between 2000 to 2005. This rapid growth led us to move to a new facility in Airdrie, Alberta. We now employ 34 people and operate a 12,500-square-foot facility sitting on 1.6 acres. The facility gives us the ability to fabricate customized packages for our customers. It is also a full service shop where we can overhaul and service air compressors.

### Please describe your oil-field instrument air packages.

Compressed air in the oil field is used for instrument air. Most control valves and actuators, in the oil and gas industry, are air operated. The design specifications call for unmanned compressed air systems. Due to the low ambient temperatures here, the compressed air must be dry air with pressure dew points to  $-40^{\circ}\text{F}$  ( $-40^{\circ}\text{C}$ ). Some installations will also specify a  $-100^{\circ}\text{F}$  ( $-73^{\circ}\text{C}$ ) dew point.



## GROWTH IN ALBERTA: NORTHWEST EQUIPMENT



*This building contains redundant rotary vane air compressors, a wet air receiver and a regenerative desiccant dryer — all under a PLC controller for remote control.*

When they build a gas plant or an oil-field facility, they want a self-contained building for the compressed air system. Northwest Equipment fabricates turn-key buildings for this industry. The building has full electrical capabilities with a main power supply, lighting, heating and full insulation of the skid. All the customer has to do is connect the skids to the steel pilings underneath and connect power to the building.

We provide the buildings with thermostatic climate control. We need enough ventilation in the summer and heat control during the winter using heaters. Most of the skids underneath the building have holding tanks where all the oily condensate goes. A vacuum truck comes to the building site and collects the oils to then dispose of them properly. Alberta has strong “Green Initiatives” and oily condensate cannot be dumped into the ground.

These compressed air packages will have two air compressors, a wet air receiver and a regenerative desiccant air dryer. We use reciprocating rotary vane and rotary screw air compressors and always have built-in redundancy. If one air compressor goes down, they can start the second one. Depending upon the air compressor application, we will sometimes use a VFD package. The system is operated by a PLC controller, which is tied into the customers’ remote DCS system. In this manner, the customer maintains full operational control of the air compressors from a remote location.

Over the years, we have also seen natural gas used instead of compressed air to run the instruments. Many installations use “instrument gas,” dry it and then run valves off of the natural gas. The problem with “instrument gas” is that now you are not allowed to vent the excess gas or flare it. There is therefore a big push to go back to compressed air for instruments.

### **Please describe your service department.**

Ninety-five percent (95%) of the air compressors we sell get a Preventative Maintenance contract. In Alberta, we have a tremendous shortage of people. The labor shortage is caused by the ever-growing oil sands exploration in Northern Alberta. All businesses here have a shortage of people and therefore focus on having a good relationship with a vendor who will take good care of their air system.

Northwest equipment has a veteran service group and we also have developed a process to train and develop our own service technicians. This in-house training program is a critical part of our growth strategy. As the business grows, Northwest has been able to continue to grow the service department (despite the labor shortage) by training our own technicians. Our training is done in collaboration with the Southern Alberta Institute of Technology ([www.sait.ca](http://www.sait.ca)) which develops journeymen millwrights. Classroom training covers the fundamentals of mechanical equipment, bearings, metallurgy and understanding lubricants.

Northwest Equipment will hire a young person and invest in the following four-year training process which includes:

1. Year 1: Eight weeks of school at SAIT. Work in our fabrication and production department.
2. Year 2: Eight weeks of school at SAIT. Work on the “grease rack” which is to do the Preventative Maintenance route under the supervision of one of our journeymen millwrights.
3. Year 3: Eight weeks of school at SAIT. Work on the PM route and begin air compressor and blower troubleshooting and rebuilding — always under supervision.
4. Year 4: Eight weeks of school at SAIT with focus on electrical education. Return now as a “4th Year Road Warrior” at Northwest Equipment and can conduct service calls. Pass the test to become a Journeyman Millwright with the license to work on rotating equipment in any plant in Alberta. If they pass the “Red Seal” test, they can work across Canada.



*Fabricated Instrument-Air Skids can include rotary vane air compressors, desiccant air dryers and storage tanks.*

Alberta



## GROWTH IN ALBERTA: NORTHWEST EQUIPMENT



*Service Coordinators Cindy McKinnon, Patti Van der Meer and Tracey Bruno of Northwest Equipment.*

In addition, we send these millwrights-in-training to the factory service training programs provided by our vendors (CompAir, Tuthill and Airtek). We will pay for the training for them as it further focuses their expertise.

Journeymen millwrights make very good wages with Northwest Equipment. The training program is set up to build the candidates into a career. The Journeyman Millwright earns \$27 per hour. We pay our trainees 60/70/80/90% of the Millwright rate in their training years one through four. When they pass the Millwright test they begin at 100% of the rate. Northwest Equipment currently has two ticketed millwrights (one has Red Seal) on staff. We have five others who are in the training program.

### **Please describe your business with “standard industry.”**

We provide compressed air to all industries. We have veteran employees with long relationships with the woodworking shops, the bakeries, the food and drug industry, meat packing plants, blow molding plastics and mining and lumber...to name a few industries using compressed air.

Our primary focus is to supply compressed air systems in Western Canada. We do supply special packages into other parts of Canada. In Quebec, for example, we do a lot of work with the aluminum foundry businesses. We fabricate special compressed air packages, which can withstand their high-ambient temperatures in the foundries. They install air compressors on the bridge cranes so the operators have utility air (like for impact wrenches to open the castings).

Another area we've had success is in HVAC packages on high-rise buildings. We've converted a lot of piston compressors to rotary vane air compressors. Each high-rise building probably has two to four 15–20 horsepower (hp) air compressors in their mechanical areas for control air. We have done a lot of retrofits with Variable Speed Drive rotary vane air compressors packaged with storage tanks. High-rise buildings are large energy consumers and the property management companies (like GWL and Oxford Properties) are focused on energy savings. We are seeing about 30% energy savings with our packages.

Northwest Equipment also represents Tuthill Blowers across all of Canada. We have grown the business by four times since beginning to work with the technology. Our focus is on pneumatic conveying systems and wastewater treatment. We sell to OEM's and have set up distributors across Canada.

### Is there a push to save energy in Alberta?

Years ago, it was hard to talk in Alberta about energy savings. Factories only paid two cents a kWh! Five years ago, however, the industry was deregulated and energy costs are no longer subsidized and the blended rate is now at nine cents per kWh! Industry is now very interested to hear about how we can optimize their compressed air systems to reduce energy costs.

The privately-held utility companies do not currently offer any incentive programs with rebates for compressed air equipment. Trans-Alta, Alberta Energy and Calpine are some of the utility companies we work with. Alberta does have a government-driven program to reduce carbon emissions. It is becoming very politically correct for industry to adopt greenhouse-friendly approaches. Most corporations, therefore, are very interested in our auditing programs.

### Please describe your audit programs.

Northwest Equipment is conducting a significant volume of compressed air audits and implementing many energy-saving compressed air and blower projects. Most customers have had a hard time reviewing their system over the years. They have historically just bought more air compressors. While most applications in Alberta have smaller (less than 100 hp) systems, we find that the potential savings make the work worthwhile for our clients. Our top two methods to find energy savings are to:

1. Data-log a compressed air system for one week **FREE OF CHARGE**. We monitor kW consumption of the system and review opportunities with the customer. The most common solution is to replace older partially-loaded equipment with air compressors using the new Variable Speed Drives which can match energy consumption with demand.
2. Conduct a compressed air "inappropriate uses" audit. Common mis-applications for compressed air include blow-off applications in steel (high-pressure air to cool down steel) and food processing applications. We collaborate successfully on many projects like this with Mr. Ed Ball of Process Air Solutions. **BP**

### Thank you, Northwest Equipment, for your insights.

For more information, please contact Mr. Sid Van der Meer, Northwest Equipment Ltd,  
email: [sid@nwequipltd.com](mailto:sid@nwequipltd.com), tel: 01-403-945-1988, [www.nwequipltd.com](http://www.nwequipltd.com)







# VACUUM PUMP INLET FILTRATION

BY DOCTOR VACUUM

## Inlet Filtration

Nearly all vacuum pumping technologies have some degree of sensitivity to inlet particulate contamination. Since everything from a vacuum-assisted production process ends up at the inlet of the vacuum pump, it is important to figure out how to best protect the pump in that particular environment. In many cases, the expected service life of a vacuum pump comes down to how well it is protected from incoming contamination.

Vacuum pump inlet filtration comes in many forms. From simple screen-type filters to elaborate bag houses, there are an enormous number of configurations to choose from. The key is to match the requirements of the vacuum pump to the process or application so that the vacuum pump is adequately protected without spending excessive capital. In other words, do the job, but don't overdo it. There are three key factors to consider when designing an inlet filtration system for a vacuum pump: particulate retention, pressure drop and serviceability.

## Factor #1: Particulate Retention

Particulate retention is simply how efficient a filter media is at trapping a particle. In the filtration business, particles are usually measured in microns. A micron is 1/1000th of a millimeter or 1/25,400th of an inch. To give you an idea of the scale we are talking about, the average human hair is about 50 to 100 microns in diameter. The smallest object a human eye can see is about 40 microns. Filtration media is specified by providing an attenuation efficiency for a given size particle. Each type of filter media has an efficiency curve that illustrates how well that media does at trapping a range of particulates. It is not descriptive enough to use terms like 10-micron media to describe a particular media. A media that filters at an efficiency of 80% at 10 microns is clearly not as effective as a media that filters at an efficiency of 99.7% at 10 microns. Typical filter media's are paper, polyester and metal/mesh screen. Also note that higher velocity through a media will reduce its efficiency. It is therefore important to keep airflows below the recommended maximum velocity so that rated efficiencies are maintained.

Particulate retention is an important consideration in vacuum pump installations and it is important to know exactly what is getting to the vacuum pump. A good example of why this is important is an installation where a significant portion of the particulate load is less than one micron in diameter. A standard 10- or 5-micron filter will trap a portion of the smaller particulates but over time there will be a buildup of small diameter contamination in the vacuum pump. Some vacuum pump technologies are able to handle this situation without incident, but many other technologies will have severe problems ingesting a heavy load of small particulates. The result will be vacuum pumps that need to be taken off line to be cleaned or in more serious situations, vacuum pumps that will have to be repaired or replaced. In either case, this is a problem that has high maintenance or production downtime costs associated with it. With a little bit of advance research, this problem can be avoided.

## Factor #2: Pressure Drop

The next consideration is pressure drop across inlet filters. Pressure drop is simply the difference in vacuum between the inlet of the filter and the discharge of the filter. Pressure differential across inlet filtration can be important in that if it is excessive, there are higher costs associated with operation of the vacuum pump. High vacuum differentials result in a higher capacity requirement. In simple terms, the vacuum pump has to create a deeper vacuum to account for the loss across the inlet filter. If vacuum pump capacity is fixed, the result will be a loss of vacuum at production equipment.

## Factor #3: Serviceability

The final key component is serviceability. It is recommended that whatever design being used have elements that are easy to clean or change. Most vacuum pump applications have single inlet filter configurations. In this scenario, the vacuum pump must be shut down to change or clean inlet filter elements. A better arrangement is to install a dual- inlet filter system so that one side can be cleaned while the other side is in operation. In this manner, low differentials can be maintained throughout the production cycle and demand applications can realize maximum vacuum at the point of use. Also note that when servicing cartridge style filter elements, it is important to keep debris out of the pump inlet when the loaded element is removed from the filter housing.

## Conclusion

Inlet filter design should not be taken lightly. The best course of action is to obtain a particulate sample and send it to a capable lab for analysis. They will provide a full report on particulate size distribution so that decisions can be made regarding media and filter configurations. Also, contact your vacuum pump manufacturer for information on how much and what size particulate their vacuum pump can tolerate. For very small particulates, specialty media such as HEPA (high-efficiency particulate air) or ULPA (ultra-low penetration air) may be required. Once this information is gathered, design the inlet filter for low-pressure drop and easy serviceability. The benefits to this process will be longer service life of vacuum pumps and extended production uptime. **BP**

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

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**“In many cases, the expected service life of a vacuum pump comes down to how well it is protected from incoming contamination.”**

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# Real World Best Practices

by Hank Van Ormer

## APPLYING AIR HOSE AND QUICK DISCONNECTS FOR OPTIMUM PERFORMANCE

Almost all manufacturing plants run some distribution of compressed air to some of the final production areas or processes. Proper selection and application of air hose when used and the accompanying quick disconnects is very critical to achieving optimum performance of the process. “Extra pressure” means “extra energy use” and “extra flow generated.”

This is an area where our compressed air system audits often find significant opportunity for savings. Often the total system is run at a higher pressure to offset the pressure loss from the main headers to processes or air tools caused by too small diameter hose and/or incorrect quick disconnects for the pressure/flow relationship.

The most important data required to size the feeds correctly to any process is the amount of flow (in scfm) required **at the entry** to the tool or process and the minimum pressure required **during operation** at the same entry. If line size was implemented by connection size, i.e:  $\frac{3}{8}$ " connection =  $\frac{3}{8}$ " hose, you can be pretty sure it is too small.

For Example:

Most air tools are designed to perform with a nominal 90 psig inlet pressure. The designer really sizes for full flow at about 80 psig at the tool entry point for optimum performance. Pressures significantly higher than 90 psig *may or may not* increase performance (depending on the tool), but lower pressures certainly will reduce performance. In many cases too high and too low pressure can cause tool damage and significantly reduce the time between rebuilds.

### Summary of Technical Performance Data (Appendix A)

The table on the following page shows selected technical data from an air tool manufacturer's engineering manual. It clearly shows the magnitude of performance loss from too low pressure on various air tools and air motors.



INLET AIR PRESSURE		½ –¾ HP CLASS		1–1.5 HP CLASS		2–3 HP CLASS	
		½ HP	¾ HP	1 HP	1.5 HP	2 HP	3 HP
60 psig	Maximum HP	.35	.47	.765	.927	1.74	2.32
	Scfm at maximum HP	20	20.1	27.5	30	51	67
70 psig	Maximum HP	.41	.58	.95	1.15	2.16	2.88
	Scfm at maximum HP	21	53.4	32	35	59.6	78
80 psig	Maximum HP	.5	.69	1.13	1.38	2.58	3.44
	Scfm at maximum HP	22	26.7	36.5	40	68	89
90 psig	Maximum HP	.57	.8	1.4	1.5	.30	4.0
	Scfm at maximum HP	24	30	39	42	76.5	100
100 psig	Maximum HP	.65	.91	1.5	1.82	3.42	4.56
	Scfm at maximum HP	26	33	45	50	85	111

## Performance Parameters

- Most air tools manufactured for North American use are designed not to run over 100 psig inlet pressure unless specifically stated
- The average tool is designed for optimum performance between 80 and 90 psig inlet pressures. At 70 psig, most will still operate, but below rating. At 60 psig, the performance is seriously affected and will probably be unacceptable. Below 60 psig is not really considered a viable option. The approximate losses at various inlet pressures in the 1 hp to 3 hp class air motors are:

100 psig to 90 psig — 7% to 17%  
 90 psig to 80 psig — 7% to 16%  
 80 psig to 70 psig — 17%(+)  
 70 psig to 60 psig — 20%  
 100 psig to 60 psig — 50%  
 90 psig to 60 psig — 39%  
 80 psig to 60 psig — 33%

## Summary

- Inadequate compressed air supply will result in **drops in power** and probable **losses in rpm**. Both of these will have a very significant impact on productivity.
- Air supply to a process and/or tool operation, should be made knowing the **total full operational flow** and the length of hose to be used along with the **minimum effective inlet pressure**. Do not use connection size as a guide!

## Hose selection

For example: the most common hose sizes for plant use are ⅜" to ¾" with 300 psig working pressure.

The selection of air hose size is often left to the operator from a choice of ⅜", ½" or ¾" and 1" hose. The operator often selects the ⅜" hose regardless of tool used because:

- ⅜" hose appears to be the lighter and “easiest to handle.” ⅜" hose is not generally recommended for industrial or automotive applications.

## REAL WORLD BEST PRACTICES

### APPLYING AIR HOSE AND QUICK DISCONNECTS FOR OPTIMUM PERFORMANCE

- A 50' length of  $\frac{3}{8}$ " and  $\frac{1}{2}$ " hose weighs about 13 lbs. depending on grade and a 50' length of  $\frac{3}{4}$ " hose weighs 22 lbs.
- The operator may or may not be trained as to what size hose is required to run the tool.

#### Recommendation

Pneumatic tools used in most plants are what we refer to as “industrial tools.” The attached flow charts and data sheets reflect premium black industrial air hose which points out several things:

- $\frac{3}{8}$ " is not considered as a viable supply hose for industrial tools. The smallest “industrial” power tool hose recommended is  $\frac{1}{2}$ ".
- Using vertical grinders as an example, they use the following flow (cfm) by hp class to determine approximate pressure loss.

#### Obviously

- $\frac{1}{2}$ " hose in 50 ft. lengths is really only applicable to 1 hp or smaller tools, air motors, etc. (Approximately 30 cfm/hp).
- $\frac{3}{4}$ " hose is acceptable at 60–90 scfm flow (2 hp–3 hp) depending on the length of run.
- For long runs (more than 50'), run larger hose or pipe supported on the walls or ground as required to eliminate pressure loss.
- To allow the operators more comfortable and easier operation, an 8 ft. to 10 ft. “whip hose” can be added to the larger  $\frac{3}{4}$ " or 1" main line which may well have minimal effect on the performance but still gives the operator the “feel” of the lighter hose.

- There is no reason to run a “longer hose” than necessary to reach the worksite and offer appropriate maneuverability for the operator if required. We often see “extra hoses” rolled up — this just steals pressure. Cut the hose to the proper length and install fittings as needed.
- Often piping can be used to minimize the required hole length.
- OSHA safety requirements: Going from  $\frac{1}{2}$ " to larger hose will require personnel to run with a mandatory automatic air shutoff valve or “safety velocity fuse.” They are an excellent safety device when correctly applied. Reference the following document: *U.S. Department of Labor, Occupational Safety and Health Administration — Power Operated Tools 1926.302, page 2, paragraph 1926.306(6) (7) — the “safety velocity fuse” is required on all hoses exceeding  $\frac{1}{2}$ " inside diameter.* This will of course not be required on hard piping or metal tubing.

#### An Actual Case Study

**More often than not, certain processes require a minimum pressure. These “requirements” should always be traced to their origin. Are they actual OEM specifications or simply the perception of an operator or supervisor?**

#### Example

At a recent plant audit the client ran the plant headers at 100 to 110 psig because a very critical hand tool grinding process “required 98 psig to run correctly.” According to the production supervisor, “My grinders need 98 psig to run properly. Therefore, the system should

	CFM / 90 PSIG	PRESSURE LOSS PSIG / 50 FEET		WT	FT
		$\frac{1}{2}$ "	$\frac{3}{4}$ "	$\frac{1}{2}$ "	$\frac{3}{4}$ "
1 HP	30 cfm	2.4 psid	.4 psid	.27	.44
2 HP	60 cfm	14.89 psid	2.2 psid	WT 50 FT	
3 HP	90 cfm	41 psid	4.6 psid	13.5 lbs.	22 lbs.
(Does not include fittings)					

run at 98 psig or higher.” When you hear these words, what is the supervisor really telling you? In this case, when the system header pressure falls below 98 psig, the grinders don’t work well. Production personnel did not know the actual pressure at the tool or how much air the tool uses.

The rest of the plant could have run at 80 psig, but it ran at 98 or more because the grinding area supposedly required it. Furthermore, grinding accounted for only 20% of the demand, so 80% of the plant was supplied with air at a much higher pressure than needed. The higher pressure throughout the plant amounts to thousands of dollars a year in increased energy (6%) to produce and increased flow (15%) of all unregulated air throughout the system.

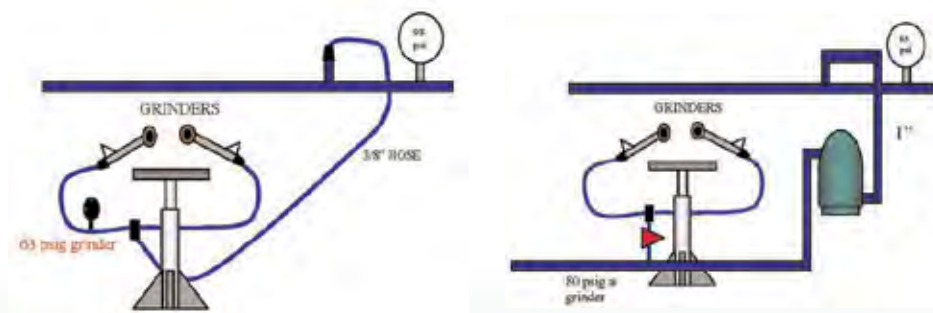
Testing with a “needle gauge” at full operation revealed that the actual inlet pressure to the tool was 63 psig at load, but the header pressure stayed at 98 psig. In other words, a 35 psig pressure loss occurred through the plumbing between the header pipe and each grinder. Further testing revealed that the grinders needed only 75 psig for optimum performance at this specific process.

In this case, operators felt the recommended  $\frac{3}{4}$ " hose to be too heavy, so  $\frac{3}{8}$ " hose was used instead. The smaller hose restricted air flow, which created a substantial pressure drop. Furthermore, the  $\frac{3}{8}$ " hose used “standard  $\frac{3}{8}$ " quick disconnects”, which contributed even more to the high pressure drop.

The two standard  $\frac{3}{8}$ " quick disconnects, accounted for a combined pressure loss of 23 psig per station, were replaced with larger capacity  $\frac{3}{8}$ " quick disconnects at \$2.50 extra per set. Doing so reduced the combined pressure loss to only 2 psig per station.

The  $\frac{3}{8}$ " hose was replaced with an 1" pipe running to the base of the workstation at a cost of \$30 per station. A regulator was selected to deliver full flow to the grinders at 75 psig with 80 psig(+) feed pressure. We were then able to reduce the header pressure to a controlled 85 psig. Results after 18 months:

- Tool repair costs went down for the grinders.
- Production was increased throughout the plant by 30% including installing more grinders and other new equipment.
- The cost of materials to implement the changes amounted to \$1,362.
- Total operating hp during production fell from 1,500 hp to 1,400 hp with a 30% increase in production.



**“In many cases, too high and too low pressure can cause tool damage and significantly reduce the time between rebuilds.”**



## REAL WORLD BEST PRACTICES

### APPLYING AIR HOSE AND QUICK DISCONNECTS FOR OPTIMUM PERFORMANCE

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“Air hoses and quick disconnects both have the same best practice guidelines — do not select or apply them without all the data.”

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The key to this success was measuring the end use workstation inlet pressure when equipment was idle and when working while simultaneously measuring the header pressure. If the header pressure stays steady, and the process inlet pressure falls, then the restriction is in the feed line from the header to the process.

This example shows that the small compressed air hose was only part of the problem (12 psid), the other part (23 psid) was poor selection of quick disconnects.

There are many types of fittings to connect hose to air supply and workstations and often, but not always, the “quick disconnect” is the best answer for overall productivity.

Regardless of the fitting, the same rules apply — size the quick disconnect for the maximum expected flow and the allowable pressure loss if any. This performance data is available from all quick disconnect manufacturers.

#### Some Quick Disconnect Guidelines

- Never select by the connection size — select by acceptable performance at specified flow and entry pressure.
- If the plant wants to utilize the **same quick disconnect** on all processes for flexibility — do it!! But, *be sure to size for the single largest flow demand in the plant at the lowest expected pressure.*
- Remember, there may be two quick disconnects per feed and sometimes more.
- All larger quick disconnects should be of the style to shutoff the flow when disconnected to eliminate potential “hose whip.” This is a safety issue.
- There are exhaust type quick disconnects (meeting ISO 4414) available that not only shutoff air flow to control hose whip but also bleed off the trapped air inside the coupler/connection in a controlled pressure release. This eliminates blasting compressed air onto the operator at disconnect. Another safety issue. Of course it is also much easier to uncouple a depressurized quick disconnect.
- Quick disconnects should have proper safety latches, wires, keepers or be of the design that will not open when dragged over the ground, floor and/or machinery.

**Do not** assume because the couplers look to be similar in diameter, length and connection size that they are similar in performance.

On a recent audit to help select the proper disconnect for a major tool operation, we ran pressure loss comparisons between two specific types of quick disconnect.

A lock ring coupler with a ball check nipple and the exhaust type coupler with a standard nipple — these units all had the same size coupler body at 1¼" diameter and connections of ½" and ¾".

The lock ring type coupler utilized a ball check to shutoff the air in that direction. The exhaust type couplers have the full shutoff and exhaust to allow disconnect at zero pressure.

## Comparing Pressure Loss:

Referring to the 80-psig inlet pressure curve, pressure loss versus flow

FLOWS CFM	GRINDER / SANDER HP	CHIPPER / BREAKER WEIGHT	PRESSURE LOSS ½" QD LOCK RING TYPE	PRESSURE LOSS ½" QD EXHAUST TYPE	PRESSURE LOSS ¾" QD LOCK RING TYPE	PRESSURE LOSS ¾" QD EXHAUST TYPE
30	1 HP	30 lbs.	4.4 psid x 2 8.8 psid	2.8 psid x 2 5.6 psid	1.5 psid x 2 3 psid	.5 psid x 2 1 psid
60	2 HP	60 lbs.	12 psid x 2 24 psid	6.5 psid x 2 13 psid	3.2 psid x 2 6.4 psid	2 psid x 2 4 psid
90	3 HP	90 lbs.	30(+) psid x 2 60 psid	16 psid x 2 32 psid	5.5 psid x 2 11 psid	4 psid x 2 8 psid

## Comments to the preceding chart (performance curves)

- There is a significant difference in the pressure loss between the Ω class quick disconnects. The exhaust coupler could work in an acceptable manner from less than 30 cfm to as much as 60 cfm (for example, on a whip hose) and still maintain 100 psig inlet above 80 psig to the tool or 90 psig inlet air 70 psig to the tool. The current lock ring/ball check nipple ½" quick disconnect appears acceptable at 30 cfm but at 60 cfm will probably not be acceptable.
- The ¾" quick disconnects are closer in performance but the lock ring/ball check type has 30–40% more pressure loss.
- The ¾" lock ring/ball check nipple quick disconnect supplied for test did not have the ball check valve in the nipple which accounts for its lower pressure drop compared to the ½" lock ring coupler which did. This of course means that the safety feature to control potential “hose whip” is not incorporated into the ¾" lock ring set. We do not consider the ¾" hose or quick disconnect a viable option in this application.

## Summary

Air hoses and quick disconnects both have the same best practice guidelines — do not select or apply them without all the data. Too often, because they are a low initial cost system component, they are purchased and applied without a great deal of thought and effort. Misapplied they will “steal” great amounts of profit! **BP**

For more information, contact Hank Van Ormer, tel: 740-862-4112, email: hankvanormer@aol.com, [www.airpowerusainc.com](http://www.airpowerusainc.com)



# RESOURCES FOR ENERGY ENGINEERS

## TRAINING CALENDAR

TITLE	SPONSOR	LOCATION	DATE	INFORMATION
Energy Management Training	Masters' Academy	Milwaukee, WI	9/22–26/2008	<a href="http://www.mastersacademy.biz">www.mastersacademy.biz</a>
Fundamentals of Compressed Air	Compressed Air Challenge®	Longview, WA	9/30/2008	<a href="http://www.compressedairchallenge.org">www.compressedairchallenge.org</a>
Advanced Management of Compressed Air	Compressed Air Challenge®	Longview, WA	10/1/2008	<a href="http://www.compressedairchallenge.org">www.compressedairchallenge.org</a>
Fundamentals of Compressed Air	Compressed Air Challenge®	Scottsdale, AZ	10/1/2008	<a href="http://www.compressedairchallenge.org">www.compressedairchallenge.org</a>
Best Practices in Compressed Air	World Energy Engineering Conf.	Washington D.C.	10/2/2008	<a href="http://www.energycongress.com">www.energycongress.com</a>
Humidity Measurement Training Seminar	Vaisala	Toronto, ON	10/8/2008	<a href="http://www.vaisala.com/seminar">www.vaisala.com/seminar</a>
Fundamentals of Compressed Air	Compressed Air Challenge®	Louisville, KY	10/15/2008	<a href="http://www.compressedairchallenge.org">www.compressedairchallenge.org</a>
Fundamentals of Compressed Air	Compressed Air Challenge®	Bend, OR	10/16/2008	<a href="http://www.compressedairchallenge.org">www.compressedairchallenge.org</a>
Compressed Air Management	Power Supply Industries	Fenton, MO	11/4/2008	<a href="http://www.psiind.com">www.psiind.com</a>
Humidity Measurement Training Seminar	Vaisala	Chicago, IL	11/5–6/2008	<a href="http://www.vaisala.com/seminar">www.vaisala.com/seminar</a>
Fundamentals of Compressed Air	Compressed Air Challenge®	Tempe, AZ	11/12/2008	<a href="http://www.compressedairchallenge.org">www.compressedairchallenge.org</a>
Fundamentals of Compressed Air	Compressed Air Challenge®	Fortuna, CA	11/19/2008	<a href="http://www.compressedairchallenge.org">www.compressedairchallenge.org</a>
Fundamentals of Compressed Air	Compressed Air Challenge®	Omaha, NE	3/24/2009	<a href="http://www.compressedairchallenge.org">www.compressedairchallenge.org</a>
Advanced Management of Compressed Air	Compressed Air Challenge®	Omaha, NE	3/25/2009	<a href="http://www.compressedairchallenge.org">www.compressedairchallenge.org</a>

*Editors' Note: If you conduct compressed air system training and would like to post it in this area, please email your info to [rod@airbestpractices.com](mailto:rod@airbestpractices.com)*



## PRODUCT PICKS

### New Compressor Selection Guide

Kaeser announces a free new compressor selection guide. This eight-page publication takes you step-by-step through the process of evaluating and selecting the right compressor for your needs. This four-color guide sheds light on the different types of air compressors, evaluating compressed air systems, selecting an air compressor, and maintenance. It details compressed air requirements and the cost of compressed air, as well as the global standards for compressed air quality. A compressed air glossary, rules of thumb, troubleshooting

guides and conversion formulas are also provided as valuable engineering references. With information on the industry's hottest trends in remote monitoring, drive technology and integrated systems, this helpful resource makes sure you get the most for your compressed air investment.

#### **Kaeser Compressors**

*Tel: 800-777-7873*

*www.kaeser.com*

### New Dew Point Transmitter

Kahn Instruments announced the new Easidew I.S. Transmitter. The Easidew I.S. is a low cost, intrinsically safe, loop-powered (2-wire) dew point transmitter for continuous measurement of the moisture content in hazardous area applications. Key features include:

- FM and CSA certification for use in Class I, Division 1, Groups A, B, C & D T4 hazardous locations.
- The ability to be connected in a 2-wire, loop powered configuration, while maintaining complete backward compatibility with all existing 3-wire installations.
- An output that is configurable in either dew point or PPMv moisture content (0–100, 0–1,000 and 0–3,000 PPMv ranges).
- A 10 micron High Density Polyethylene (HDPE) sensor guard designed to show contamination for service ease.
- Small footprint — the same dimensions as the Kahn Easidew 2-Wire Transmitter.

The Easidew I.S. Transmitter has a dew point measurement range of -148 °F to +68 °F, an accuracy of  $\pm 3.6$  °F and operates from any 12 to 28 VDC power source. The instrument also features a field adjustable, 4–20 mA, linear analog output, resettable failure modes for Over Range, Under Range and Sensor Fault conditions and temperature compensation.

#### **Kahn Instruments**

*Tel: 860-529-8643*

*Email: [hygros@kahn.com](mailto:hygros@kahn.com)*

*www.kahn.com*



### New Diesel Generator Compressor

Service vehicles and race car trailer owners who want to conserve valuable space have to look no further than Next Generation Power. Their latest product combines a powerful generator and heavy-duty compressor into one, compact unit. The sleek Generator Compressor measures just 42" L x 26" D x 30" H and weighs only 375 lbs.

Now diesel-powered vehicles no longer need to have a separate fuel supply for gasoline compressors and generators. Able to run on the same fuel system, the two-in-one, diesel-powered Generator Compressor produces 20 cfm at 150 psi and 5 kW of electrical power. Operating at a very low 1,000 rpm for longer service life, the powder-coated, belt-driven Schulz air compressor has all CNC-machined parts.

This diesel-powered unit offers a longer life, lower maintenance and better fuel efficiency than gasoline. Tried and true, the efficient Next Generation Power gen-set features a durable, 2-cylinder Kubota Z482 engine. Water-cooled, it runs at mid-speed, peak torque at a comfortable 2,800 rpm. A vortex combustion system creates greater energy output with less fuel consumption and cleaner burning exhaust. Suggested retail price of the Generator Compressor is \$6,495.



#### **Next Generation Power**

*Tel: 888-463-9879*

*Email: [ngpowersales@bellsouth.net](mailto:ngpowersales@bellsouth.net)*

*www.nextgenerationpower.com*

# Wall Street Watch

BY COMPRESSED AIR BEST PRACTICES™



The intent of this column is to provide industry watchers with publicly held information, on publicly held companies, involved with the sub-industry of compressed air. It is not the intent of the column to provide any opinions or recommendations related to stock valuations. All information gathered in this column was on September 8, 2008.

**Minneapolis, September 2, 2008 — Donaldson Company, Inc. (NYSE: DCI)** announced fourth quarter diluted earnings per share (“EPS”) of \$0.60, a 13% increase from \$0.53 in the prior year. Net income was \$48.6 million, up 12% from \$43.3 million last year. Sales were \$607.4 million, a 16% increase from \$524.7 million in the fourth quarter of 2007.

For the year, EPS was \$2.12, an increase of 16% from \$1.83 last year. Net income increased 14% to \$172.0 million versus \$150.7 million last year. Sales were \$2.2 billion, up 16% from \$1.9 billion in fiscal 2007.

“We are very pleased to announce that we have achieved our 19th consecutive year of record earnings,” said Bill Cook, Chairman, President and CEO. “We also set a new sales record in the fourth quarter, exceeding \$600 million for the first time, and a new sales record for the year as we delivered our first \$2 billion sales year. Our sales strength was broad-based again this quarter as Engine Products were up 13% and Industrial Products were up 20%. Geographically, sales grew 24% in Europe and 17% in Asia, driven by the combination of organic sales volume growth and the benefits of the stronger foreign currencies, and sales grew 9% in NAFTA.”

“Our sales trends remain positive as we enter fiscal 2009. We expect to continue making progress on our operating improvement initiatives while continuing to invest in our business for future growth. Although we expect raw material costs to continue to increase, we will work to offset the impact through internal cost reduction efforts, raw material price indexing in some markets and price increases in other markets. While we are cautious about global economic conditions, we believe that the combination of our business model and extensive diversification of our products, end markets and geographies will lead to our 20th consecutive year of record earnings.”

### Financial Statement Discussion

Our gross margin was 33.2% for the quarter and 32.5% for the year, compared to prior year margins of 32.4% and 31.5%, respectively. The primary drivers for the improved margin include higher production volumes, cost controls, productivity improvements and some recovery of previously incurred product development costs, all of which were partially offset by higher commodity costs.

Operating expenses for the quarter were 22.0% of sales, up from 20.1% last year. For the year, operating expenses were 21.5% of sales, up from 20.5% last year. The increases were driven by business mix, higher research and development costs to support our product development initiatives and higher information technology spending to improve our global customer support capabilities.

### Fiscal 2009 Outlook

**Industrial Products:** Our Industrial Filtration Solutions' sales are projected to grow 8 to 12% due to continued global manufacturing investment conditions and growing demand for our new products. We expect our Gas Turbine Products' sales to increase 5 to 10% for fiscal 2009. Continued strength is expected from both the international power generation and the oil and gas markets.

Full year company sales are expected to be up 9 to 11%.

We expect our operating margin will be a minimum of 11% for the full year.

We expect our EPS to be between \$2.30 and \$2.40 per share, which would be our 20th consecutive EPS and earnings records.

**Hamilton, Bermuda, August 1, 2008** — Ingersoll-Rand Company Limited (NYSE:IR), announced that total revenues increased by 38% for the second quarter of 2008 compared with the 2007 second quarter and EPS from continuing operations exceeded prior guidance.

The company reported net earnings of \$256.1 million, or diluted earnings per share (EPS) of \$0.88, for the second quarter of 2008. Second-quarter net earnings included \$262.5 million, or EPS of \$0.90 from continuing operations.



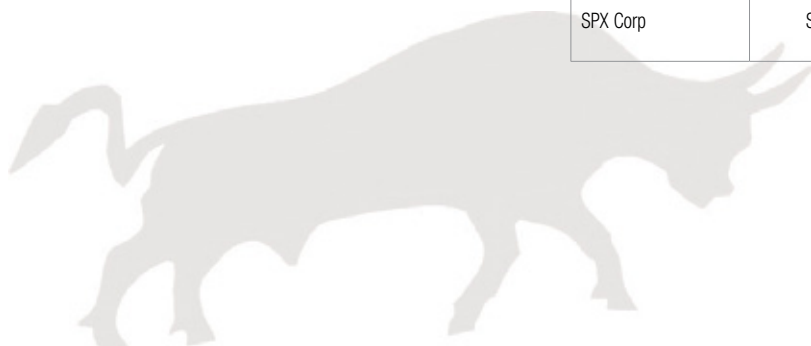
## WALL STREET WATCH

**“Our customers continue to express their confidence in our industry-leading brands and our talented people, as reflected by solid overall revenue growth.”**

“We completed a very productive quarter,” said Herbert L. Henkel, chairman, president and chief executive officer. “We finalized the acquisition of Trane, began achieving our planned synergies as we combined two strong companies and our businesses delivered stronger-than-expected results. Our second-quarter 2008 performance reflects the overall strength of our balanced business portfolio. Our products and services remain at the forefront of meeting critical needs, through energy-efficient refrigeration, air conditioning and industrial equipment; food-safety and preservation technologies; and commercial and residential security equipment and systems. Our customers continue to express their confidence in our industry-leading brands and our talented people, as reflected by solid overall revenue growth. In addition, our businesses are making important strides in operating efficiency and cost reductions. With the addition of Trane, we are a more formidable presence in the global climate control market, and we expect to significantly benefit from Trane’s expertise, technologies and people as we continue to grow.”

The company classifies its businesses into four reportable segments based on industry and market focus: Air Conditioning Systems and Services (added on June 5 with the acquisition of Trane), Climate Control Technologies, Industrial Technologies and Security Technologies.

SEPTEMBER 8, 2008 PRICE PERFORMANCE	SYMBOL	LAST PRICE	1 MONTH	6 MONTHS	12 MONTHS
Parker-Hannifin	PH	\$61.51	-4.2%	-3.2%	-17.7%
Ingersoll-Rand	IR	\$35.91	-9.9%	-17.2%	-32.6%
Gardner Denver	GDI	\$41.57	-9.7%	12.1%	6.9%
United Technologies	UTX	\$65.78	-4.2%	-5.1%	-14.6%
Donaldson	DCI	\$40.94	-10.3%	0.8%	-0.4%
EnPro Industries	NPO	\$42.91	6.6%	35.2%	-0.2%
SPX Corp	SPW	\$104.90	-10.5%	0.0%	18.2%



Industrial Technologies is focused on providing solutions to enhance customers' industrial and energy efficiency and provides equipment and services for compressed air systems, tools, fluid power production and energy generation systems. Total revenues in the second quarter increased by approximately 8% to \$806 million. Strength in industrial and process markets outside of North America and revenues from the aftermarket business continued to benefit the Air and Productivity Solutions business. Revenues in the Americas were flat compared with last year as higher recurring revenues were offset by lower equipment volumes. Air and Productivity Solutions revenues in Europe, Asia and India grew by approximately 25% compared with 2007. Second-quarter operating margin for Industrial Technologies of 12.9% declined compared with 14.6% last year, as higher volumes, improved pricing and productivity savings were more than offset by inflation, increased investment spending and approximately \$12 million from product liability and restructuring costs. **BP**



## COMPRESSED AIR BEST PRACTICES™ MAGAZINE

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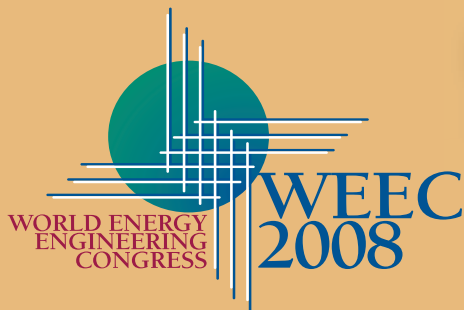
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