Tier 1 Supplier Saves $218,000 Honda of America Mfg. Waterborne Paints

March 2011

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Approaching 100 years of compressed air experience, Hitachi has been and continues to be the technology leader via continuous innovation of air compression oriented towards Customer Value. With growing concerns for the environment we live in, along with the products we consume, not only Oil Free, but Contaminant Free air is quite important.

The foundation of Hitachi Innovation is derived from more than 50 years of Oil Free Compressor technology, with the world introduction of Hitachi Oil Free Reciprocating compressors in 1954.

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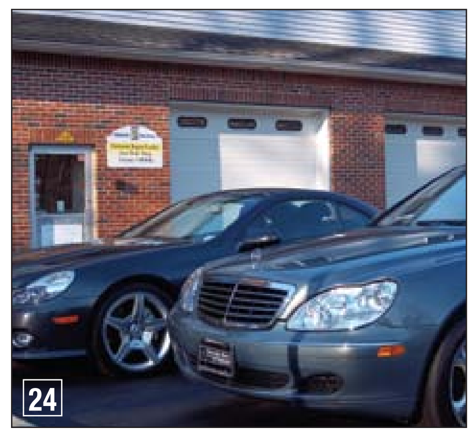
SUSTAINABLE MANUFACTURING FEATURES



COLUMNS

FROM THE EDITOR

Automotive Industry

Running a business in the automotive industry is not for the faint of heart. It's also not for those ignoring their compressed air systems! In this edition, we provide examples illustrating how a major automotive manufacturer (Honda of America Mfg.), a collision repair center (Compact Kars), and a Tier 1 automotive supplier all improved their compressed air systems.

I received the opportunity to visit East Liberty, Ohio, the site of a 2,400-man Honda of America Mfg. manufacturing facility, due to an invitation by Mike Seiter — a member of the maintenance team on the CR-V assembly line. This article is about how Mike's team was able to find demand-side savings in one of the most advanced compressed air systems I've ever seen. Maintenance departments, like Mike's, play a key role to U.S. industry fixing all the leaks and pressure drops present in the pneumatic circuits near production equipment. For those of you who think your system is perfect, please read this article.

The new U.S. EPA (Environmental Protection Agency) 6H VOC Paint Standard is driving change in compressed air system in the collision repair industry. New waterborne paints contain only two pounds of volatile organic compounds (VOC) compared to 5.65 pounds in traditional solvent-based paints. Compact Kars, an authorized Mercedes-Benz Collision Repair Center, upgraded their compressed air system to help their facility make the changes required to meet the 6H Standard. They were advised by Air & Gas Technologies and installed a new system capable of producing higher air flow and air quality.

Larger facilities, like Tier 1 automotive supply facilities, with multiple compressor rooms, have often had a hard time optimizing their compressed air systems. This month we have a system assessment article, provided by Hank Van Ormer, providing readers with an example of the information they should gather from each compressor room to analyze their supply-side situation. This facility was able to save $218,000 per year in annual electricity costs. The real take-away from this article, however, is what information one should gather and in what format.

Continuing our effort to recruit expertise from outside the U.S., we are pleased to provide you this month with, "A View From Europe: Challenge Convention: Compressor Management Systems Applied in the Automotive Industry." This article challenges some commonly held "conventions" regarding compressor controls and provides automotive industry case studies from Europe.

We hope you enjoy this edition. Thank you for your support and for investing in *Compressed Air Best Practices*®. BP

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"This article is about how Mike Seiter's maintenance team, at Honda of America, was able to find demand-side savings in one of the most advanced compressed air systems I've ever seen."

— Rod Smith

SUSTAINABLE MANUFACTURING NEWS

Nissan, Ford, Honda, General Motors

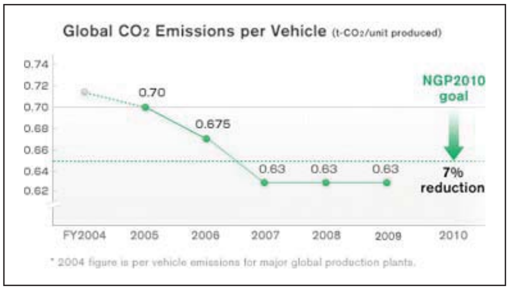
SOURCED FROM THE WEB

Nissan Green Program

More efficient use of energy is essential to reducing carbon dioxide (CO_2) emissions. At Nissan we are steadily reducing CO_2 emissions by introducing energy-saving equipment and raising efficiency at our production sites worldwide.

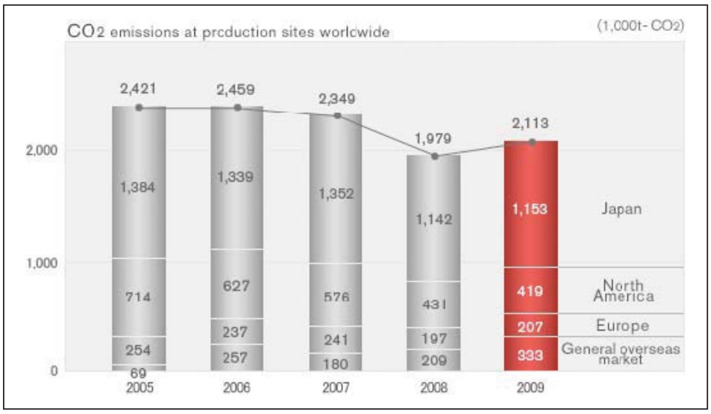
Our goal is to achieve 7% reduction in CO_2 output in global production

By 2010 we aim to reduce CO_2 emissions from our plants to 7% lower than 2005 levels (globally, per vehicle). Almost all CO_2 emissions from production processes are caused by the use of fossil fuels for the energy we consume. To produce vehicles using smaller amounts of energy, the Nissan group worldwide is working together to improve technology and devise better operation methods. We will continue to reduce CO_2 by introducing the best methods available wherever we can. We also make use of wind and solar power, and other natural energies as suited to local conditions.



Steady reductions in CO_2 emissions

The number of automobiles being manufactured worldwide is increasing every year. At Nissan we believe it is important to use energy more efficiently during production and reduce CO_2 emissions at all of our manufacturing plants around the world. In 2005, we began activities to reduce CO_2 at our overseas production sites. As a result of these efforts, CO_2 emissions from our manufacturing plants were down to about 1.98 million tons in fiscal 2008, a decrease of about 442,000 tons from fiscal 2005. In Japan, CO_2 emissions were 1.14 million tons, a 17% decrease from 2005 (and a 32% decrease from 1990), and we are on course to reach our CO_2 reduction targets set out in the Nissan Green Program 2010.



*The number of production sites differs slightly depending on the year because of increases in the number of consolidated subsidiaries and changes in the scope of management.

*The data of FY2008 covers 51 production sites.

*The data coverage is reviewed each year with priority on major production bases.

*Numbers are rounded to the first decimal place. As a result, the aggregate figures for each of the items may not match the sum total.

Source: www.nissan-global.com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SUSTAINABLE MANUFACTURING NEWS

Nissan, Ford, Honda, General Motors

Ford has reduced global energy consumption by 44% since 2000 and reduced energy consumption per vehicle by 17.7% during the same period.

Ford Reduces Global Energy Consumption

Operational energy use and greenhouse gas emissions are inextricably linked. The majority of our facilities' energy comes from fossil fuel sources, hence operational energy use is an important source of our companywide GHG emissions. Our efforts to reduce energy use and increase the use of renewable energy are also part of our strategy to reduce our GHG emissions and overall climate impacts.

Ford has reduced **global energy consumption** by 44% since 2000 and reduced energy consumption per vehicle by 17.7% during the same period. In 2009, Ford improved energy efficiency in its North American operations by 4.6%, resulting in savings of approximately $15 million. We measure energy efficiency in North America using our Energy Efficiency Index. To drive continued progress, we have set targets to improve our facility energy efficiency by 3% globally and 3% in North America in 2010.

TABLE A: FORD WORLDWIDE FACILITY ENERGY CONSUMPTION

TRILLION BRITISH THERMAL UNITS						
	2004	2005	2006	2007	2008	2009
Direct	50.8	39.0	44.6	37.3	36.7	29.8
Indirect	32.0	30.5	29.2	28.3	24.3	21.7
Total	**82.8**	**69.5**	**73.8**	**65.6**	**61.0**	**51.5**

We reduced our total **facilities-related carbon dioxide emissions** by approximately 50%, or 4.8 million metric tons, from 2000 to 2009. During this same period, we reduced facilities-related CO_2 emissions per vehicle by 27%. We have set a target to reduce our North American facility GHG emissions by 6% between 2000 and 2010 as part of our Chicago Climate Exchange commitment. The Company has also committed to reduce U.S. facility emissions by 10% per vehicle produced between 2002 and 2012, as part of an Alliance of Automobile Manufacturers program. Ford has already achieved a target to reduce absolute emissions from UK operations by 5% over the 2002–2006 timeframe, based on an average 1998–2000 baseline.

The EPA and U.S. Department of Energy again recognized Ford's energy-efficiency achievements by awarding us a 2010 Energy Star Sustained Excellence Award, which recognizes Ford's continued leadership and commitment to protecting the environment through energy efficiency. This is Ford's fifth consecutive year winning this prestigious award. The Energy Star Sustained Excellence Award requires organizations to demonstrate proficiency through the management of projects and programs, data collection and analysis, and communication actions, including community outreach and active participation in Energy Star industry forums. Among the achievements recognized by the award is a 30% improvement in the energy efficiency of Ford's U.S. facilities since 2000, equivalent to the amount of energy consumed by 110,000 homes.

Since 2007, we have been using a **utility metering and monitoring system** to collect incoming electricity and natural gas consumption data for all Ford plants in North America. We use this near-real-time information to create energy-use profiles for all Ford facilities and to improve decisions about nonproduction shutdowns and load shedding, which involves shutting down certain pre-arranged electric loads or devices when we reach an upper threshold of electric usage. During 2009, this metering and monitoring system was essential in helping us to minimize energy use during extended production slowdowns and production shutdowns. By using this tool and other best practices, Ford's manufacturing facilities reached record lows in energy use.

Ford continues to use **energy performance contracting** as a financing tool to upgrade and replace infrastructure at its plants, commercial buildings and research facilities. Through these contracts, Ford partners with suppliers to replace inefficient equipment, funding the capital investment over time through energy savings. Projects have been implemented to upgrade inefficient lighting systems, paint-booth process equipment and compressed air systems, and to significantly reduce the use of steam in our manufacturing facilities. Since 2000, Ford has invested more than $220 million in plant and facility energy-efficiency upgrades.

Ford has also established a three-year global effort to consolidate and redesign its **data centers** using best practices identified by the DOE and EPA's Energy Star program. First, we are consolidating data centers to dramatically reduce the number of managed facilities and their total energy demand. By the end of 2010, we will have consolidated 20 existing centers into just six, a reduction of 70%. We are also "virtualizing" 2,000 servers into just 100 physical servers. These consolidations will result in a 90% reduction in power needs and a 95% reduction in cooling needs.

During this process we are changing the layout of our remaining data centers to maximize their energy efficiency. By directing conditioned air into equipment racks as opposed to cooling entire server rooms, expensive chilled air is used much more efficiently, and the load on building cooling equipment is reduced. We have also developed and implemented global data center design specifications, so that all new and remodeled data centers will meet high energy-efficiency standards. This three-year data center initiative is projected to yield $35 million in operational cost efficiencies.

SUSTAINABLE MANUFACTURING NEWS

Nissan, Ford, Honda, General Motors

In 2010, we implemented a **PC power management system** to power down all of our desktop and notebook computers at night. The system, which is based on the NightWatchman® software application from 1E, overcomes many barriers of other power-down systems by allowing overnight data processing as needed, integrating power management and software delivery, and allowing custom power management solutions. We predict that this program will reduce our annual energy costs by $1.2 million and our annual CO_2 emissions by 16,000 to 25,000 metric tons.

We have implemented a **network-controlled system on plant air compressors** in our powertrain and vehicle assembly plants. This industry best-in-class system significantly reduces energy consumption by improving the operational efficiency of large, centralized air compressors. It allows for the real-time collection of key performance data through an enterprise-wide, web-based data management tool. This data is then used to determine the overall efficiency of each system and identify savings opportunities. The savings opportunity reports are sent to plant managers, who can then initiate corrective actions. The system also allows for remote troubleshooting of the equipment, which can extend equipment life and reduce maintenance costs. The system is also being used for remote operation of equipment at select facilities. As of January 2010, we had installed these systems at 29 plants on 181 compressors.

In Europe, our Dagenham facility has reduced its electricity usage per engine manufactured by 12% over the past two years. This improvement was achieved by decreasing the use of energy-intense operations, such as the generation of compressed air for handheld tools on the production line. In addition, high-energy use equipment was scientifically optimized on Dagenham's new engine manufacturing lines. This equipment requires 70% less energy per engine than was used on the existing lines. In 2007, Dagenham won national awards from two organizations – Business Commitment to the Environment and Business in the Community – for the facility's CO_2 reductions, energy efficiency efforts and other environmental actions.

FACILITIES			
METRIC	**2009 TARGET**	**2009 ACTUAL**	**2010 TARGET**
Energy Use			
Facility energy efficiency (global)	3% improvement	8% improvement	3% improvement
Facility energy efficiency (United States)	3% improvement	4.6% improvement	3% improvement
Energy use	No specific goal; continue use reductions	44% improvement compared to 2000 levels	No specific goal; continue use reductions
Emissions			
VOC emissions from painting at North American assembly plants	Maintain 24 g/sq meter or less	21 g/sq meter	Maintain 24 g/sq meter or less
Water Use			
Water use (global)	6% reduction	16.6% reduction	6% per unit reduction from 2009[3]
Waste Production			
Landfill waste (global)	10% reduction	20.6% reduction	10% per unit reduction from 2009[4]

Source: http://corporate.ford.com/

Greener Manufacturing at General Motors

Our Environmental Principles form the foundation for our manufacturing practices and each of our facilities tracks and reports its annual performance on energy use, water use, greenhouse gas emissions and waste. Our commitment to improvement and the innovative practices we've employed have helped us to make great strides in these areas.

Energy – GM is one of the leading users of renewable energy in the manufacturing sector. We use energy from solar, hydro and landfill gas resources. And around the globe we have reduced our overall energy usage globally by more than 40% between 2005 and 2009. The amount of energy we've saved from these reductions is enough to heat and power 1,300,000 homes.

Emissions – By saving energy and increasing the use of renewable energy sources, we have reduced CO_2 emissions from our facilities by 39% from 2005 to 2009.

Water – Between 2005 and 2009, we reduced the amount of water used by our worldwide facilities by nearly 35%.

Waste – To reduce the waste coming out of our facilities, we focus first on decreasing the amount of waste that is generated by our manufacturing processes to begin with. Then, for waste that cannot be avoided, we work hard to find ways to recycle those materials for use in new products – either in our vehicles or in other consumer products. We currently have 76 facilities around the world which have earned a "landfill-free" certification. This means that these facilities send no waste to landfills – it is either recycled or used to create energy. We have exceeded our goal for 2010 to have more than half our facilities landfill-free certified.

GM

Source: www.gm.com

SUSTAINABLE MANUFACTURING NEWS

Nissan, Ford, Honda, General Motors

Honda Issues 2010 North American Environmental Report

Honda released its sixth annual report on the company's environmental footprint in North America, and efforts being made to minimize the environmental impact of Honda's operations in the region. The report also includes a detailed review of the various technology approaches that Honda is taking in its efforts to address the issue of global climate change, perhaps the most serious and far-reaching environmental issue facing society today.

Highlights of the 2010 report include:

- American Honda's Corporate Average Fuel Economy (CAFE) for model year 2009 (MY2009) rose 1 mpg to 31.3 mpg, a 3.3% increase from MY2008 and a 7.2% rise from MY2005, outpacing the company's voluntary goal (set in May 2006) to achieve a 5% increase over MY2005 CAFE levels by MY2010
- Waste to landfills from manufacturing activity was reduced 87% from the FY2001 baseline and 65% from the previous fiscal year, with eight North American plants achieving zero waste to landfill, as Honda moved closer to its goal of achieving zero waste to landfill for all 14 of its plants in the region by April 1, 2011
- Total energy used in manufacturing was reduced 8% from the previous fiscal year, while energy use per automobile produced rose 2.4% as a result of lower production volumes
- Average CO_2 emissions[1] per automobile produced rose only 1% despite an 8% decrease in the volume of automobile production
- "Intelligent" paint booth technology was implemented on all automobile paint lines in North America, reducing energy used in auto body painting by as much as 25%
- Emissions of volatile organic compounds from auto body painting were reduced 9.8% from FY2008 levels to 13.8 grams/m², exceeding Honda's target of 20 grams/m²
- Two new on-site parts consolidation centers — at the Marysville, Ohio, auto plant and Timmonsville, SC, all-terrain vehicle (ATV) plant — are estimated to reduce CO_2 emissions from supplier parts shipments by nearly 1,300 metric tons annually
- Honda's North American Purchasing Division launched a Supply Chain Sustainability Initiative to promote actions aimed at reducing CO_2 emissions from supplier activity
- A new port facility in Richmond, Calif., Honda's third west coast port facility, is expected to reduce truck travel by 2.7 million miles annually, cutting CO_2 emissions from product distribution by an estimated 4,500 metric tons

Emissions of volatile organic compounds from auto body painting were reduced 9.8% from FY2008 levels to 13.8 grams/m², exceeding Honda's target of 20 grams/m².

The 2010 North American Environmental Report covers the company's operations during the fiscal year ended March 31, 2010 (FY2010) and utilizes a lifecycle assessment (LCA) model to report on the environmental impact of Honda's R&D, manufacturing and sales activities in the North America region, encompassing the United States, Canada and Mexico. The report looks at the environmental performance of the company's automobile, powersports, and power equipment products, its 14 major manufacturing plants operating in North America in FY2010, and the corporate activities of 15 Honda group companies in the region.

[1] CO_2 emissions from the consumption of electricity and natural gas, representing about 96% of total direct CO_2 emissions from Honda's North American manufacturing operations.

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Source: www.honda.com

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4. Turn off the compressed air when it isn't in use.
5. Use intermediate storage of compressed air near the point of use.
6. Control the air pressure at point of use to minimize air consumption.

1

EXAIR's **Digital Flowmeter™** accurately measures compressed air usage and monitors waste. Trends can be monitored to find excessive air use. Detects leaks at compressed air fittings when the machinery is off. Regular monitoring can detect leaks that develop as the machinery ages.

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- **Digital readout displays actual airflow through pipe**

www.exair.com/78/4dfm.htm

2

EXAIR's **Ultrasonic Leak Detector** can help you identify costly leaks in your compressed air system. Leaks can account for 30% of total compressor output! In many cases, finding one small leak can quickly pay for the leak detector.

- **Detects leaks up to 20' (6.1m) away**
- **Accurate in noisy industrial environments**

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3

EXAIR's award winning **Super Air Knives™, Super Air Nozzles™,** and **Super Air Amplifiers™** entrain large volumes of room air using only a small amount of compressed air as the power source. They dramatically reduce air consumption and noise.

- **Low cost - Replaces noisy blowers**
- **Improves blowoff performance and safety**

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MEETS OR EXCEEDS OSHA REQUIREMENTS

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EXAIR's **EFC™** is an electronic flow control that minimizes compressed air use by turning off the compressed air when no part is present. For use on blowoff, drying, cooling, conveying and static elimination operations.

- **Easy hook up 100-240 VAC with compact eight function timer**
- **Photoelectric sensor withstands water and dust**

www.exair.com/78/4efc.htm

5

An EXAIR 60 gallon **Receiver Tank** can be installed at the point of high demand so there is an additional supply of compressed air available for a short duration. Meets ASME pressure vessel code.

- **Eliminates fluctuations in pressure and volume**
- **Vertical, space saving design**

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6

EXAIR **Pressure Regulators** permit easy selection of an operating pressure that will allow the air product to work properly without using excessive amounts of compressed air. Reducing the air pressure from 100 PSIG to 80 PSIG reduces energy use by almost 20%.

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- **Many sizes available**

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THE SYSTEM ASSESSMENT

Tier 1 Automotive Plant Saves $218,000 in Energy Costs

BY HANK VAN ORMER, AIR POWER USA

Introduction

A Tier 1 automotive plant was spending $364,259 annually on electricity to operate their compressed air system. This figure was expected to increase as electric rates were forecasted to rise from their current average of 7.16 cents per kWh. Our firm, Air Power USA, conducted a full supply and demand-side compressed air system assessment. The set of projects recommended by the assessment, would reduce these energy costs by $218,670 or 60%. These projects would also allow the plant to have complete back-up of all of its compressor rooms. Estimated costs for completing the projects totaled $244,795, representing a simple payback of 13 months.

It is important that compressed air system owners understand that reducing compressed air demand (like fixing compressed air leaks) will not automatically translate into energy dollars saved. This facility, for example, did not have a networked compressor control system capable, of translating the achieved compressed air demand reductions of 1,300 acfm into energy savings for the plant. This article's primary objective is to share, with the readers, the metrics we supply our customers so they can understand the current compressor usage (without centralized controls) and the proposed compressor usage (with networked controls).

Current Compressed Air Supply-Side Summary

This automotive component plant runs three production shifts per day, five days a week and a half day shift on Saturday. Weekly non-production hours total 21 hours per week. The compressed air system, however, operates 8,760 hours per year. The load profile or air demand of this system is not relatively stable during all shifts. Overall system flow ranges from 2,009 acfm during weekends to 3,300 acfm during the first and third shift. The system pressure runs from 83 to 92 psig in the headers during production.

Annual plant electric costs for air production are $291,818 per year. If the electric costs of $72,441 associated with operating ancillary equipment such as refrigerated and desiccant air dryers are included, then the total electric costs for operating the air system are $364,259 per year. These estimates are based on a blended electric rate of $0.0716 /kWh.

THE SYSTEM ASSESSMENT

Tier 1 Automotive Plant Saves $218,000 in Energy Costs

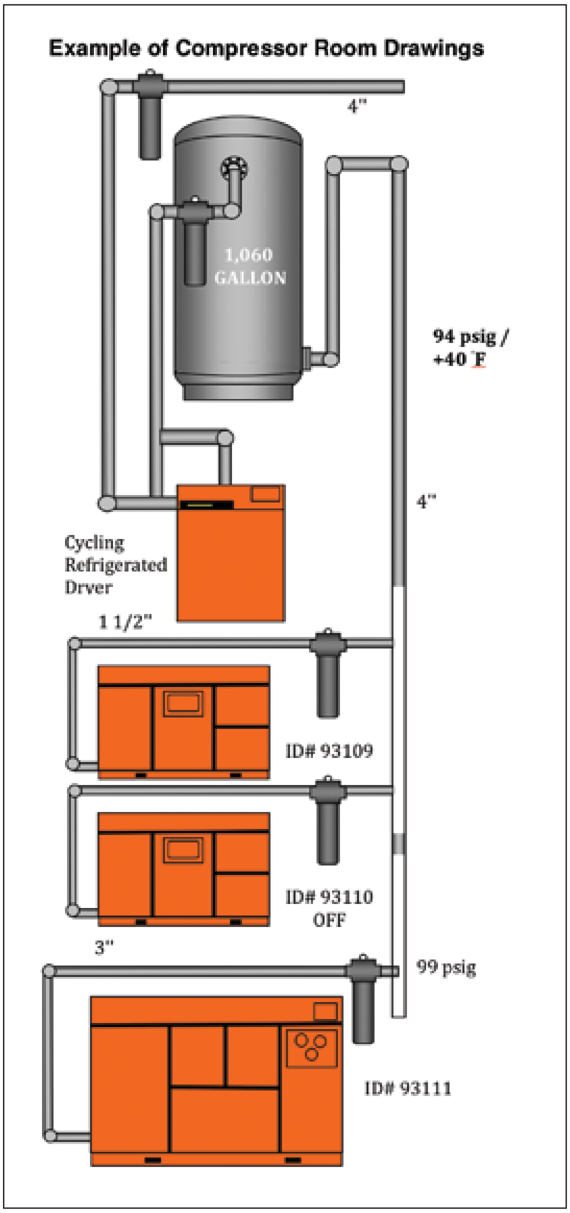


Image 1: Compressor Room 126 E Drawing

Multiple Compressor Rooms Create Confusion and Energy Costs

The plant has five different compressor rooms supplying compressed air to different parts of the factory. All five compressor rooms operate independently of one another. Each compressor room has a combination of air compressors and air dryers operating during each production shift. There existed total confusion, with plant personnel, on how much compressed air each compressor room is supplying. Our study provided the plant with an analysis of each compressor room – along with a drawing of the existing equipment installed.

Compressor Room "126E", for example, operated the following three air compressors and one compressed air dryer. Compressed air filters and a 1,060-gallon storage tank was also installed. There was:

- One 100 hp lubricated rotary screw air compressor rated for full-load 520 acfm and 85 kW at 100 psig pressure. This machine ran at full load during normal production and non-production hours
- Two 50 hp lubricated rotary screw air compressors rated for 240 acfm each and 42 kW at 100 psig. One 50 hp machine acted as back-up while the other operated at 73.5% of full load during the first shift (176 acfm), was OFF during the second shift, and ran at 40% of full load (96 acfm) during the third shift. These two compressors did not run during non-production hours
- Total available compressed air at 100 psig equaled 1,000 acfm
- One cycling refrigerated air dryer rated for 1,300 acfm. Specified compressed air pressure dewpoint at compressor room exit was + 40 °F
- Pressure loss at 520 acfm equaled 5 psid

Current Compressor Use Profile

Once we had measured and analysed what was happening in each compressor room, we put all the data together into one table. We now look at what is happening with each air compressor, by production shift. It's important to note that we measured what was happening on the weekends and holidays as well. Remember, each compressor room was operating independently of one another.

The demand-side projects were able to realize significant reductions in compressed air demand — up to 1,300 acfm.

TABLE 1: CURRENT COMPRESSOR USE PROFILE

UNIT #	COMPRESSOR: MANUFACTURER/ MODEL	FULL LOAD		ACTUAL ELEC DEMAND		ACTUAL AIR FLOW	
		DEMAND (KW)	AIR FLOW (ACFM)	% OF FULL KW	ACTUAL KW	% OF FULL FLOW	ACTUAL ACFM
First Shift: Operating at 100 psig discharge pressure for 2,080 hours							
1	108A DS140	81	520	96%	77.8	86%	448
2	104 DS140	80	520	OFF			
3	108B DS140	81	520	76%	61.6	50%	260
4	104 DS140	84	520	100%	81	100%	520
5	HVAC DSD200	177	992	100%	177	100%	992
6	126E DS140	86	520	100%	86	100%	520
7	126E BS60	43	240	90%	38.7	73%	176
				TOTAL (Actual):	**522.1**		**2,916**
Second Shift: Operating at 100 psig discharge pressure and 2,080 hours							
1	108A DS140	81	520	45%	36.45	17%	89
2	104 DS140	80	520	OFF			
3	108B DS140	81	520	76%	61.6	50%	260
4	104 DS140	84	520	70%	59	43%	224
5	HVAC DSD200	177	992	100%	177	100%	992
6	126E DS140	86	520	100%	86	100%	520
7	126E BS60	43	240	OFF			
				TOTAL (Actual):	**420**		**2,085**

UNIT #	COMPRESSOR: MANUFACTURER/ MODEL	FULL LOAD		ACTUAL ELEC DEMAND		ACTUAL AIR FLOW	
		DEMAND (KW)	AIR FLOW (ACFM)	% OF FULL KW	ACTUAL KW	% OF FULL FLOW	ACTUAL ACFM
Third Shift: Operating at 100 psig discharge pressure and 2,080 hours							
1	108A DS140	81	520	90%	77.4	73%	380
2	104 DS140	80	520	OFF			
3	108B DS140	81	520	76%	61.6	50%	260
4	104 DS140	84	520	97%	80.64	89.4%	465
5	HVAC DSD200	177	992	100%	177	100%	992
6	126E DS140	86	520	100%	86	100%	520
7	126E BS60	43	240	68%	29.2	40%	96
				TOTAL (Actual):	**511.84**		**2,713**
Weekend/Holiday Shift: Operating at 100 psig discharge pressure and 2,520 hours							
1	108A DS140	81	520	66%	50.4	30%	156
2	104 DS140	80	520	OFF			
3	108B DS140	81	520	66%	53.46	35%	185
4	104 DS140	84	520	60%	50.4	30%	156
5	HVAC DSD200	177	992	100%	177	100%	992
6	126E DS140	86	520	100%	86	100%	520
7	126E BS60	43	240	OFF			
				TOTAL (Actual):	**417.26**		**2,009**

Current Compressed Air System Characteristics

Once the compressor use profile had been established, by shift, we could develop an over-all picture of the performance of the compressed air system. We could analyze total system air flow, by shift, and figure out our annual electric costs for compressed air — by shift.

Proposed System: Compressor Use Profile by Shift

The demand-side projects were able to realize significant reductions in compressed air demand — up to 1,300 acfm. The plant, however, would not realize these gains without a new networked compressor control system allowing all the air compressors to work together. Table 3 showed the customer how the new networked system would work.

THE SYSTEM ASSESSMENT

Tier 1 Automotive Plant Saves $218,000 in Energy Costs

TABLE 2: CURRENT COMPRESSED AIR SYSTEM CHARACTERISTICS

MEASURE	1ST SHIFT	2ND SHIFT	3RD SHIFT	WEEKEND/ HOLIDAYS	TOTAL
Average System Flow	2,916 acfm	2,085 acfm	2,713 acfm	2,009 acfm	NA
Avg Compressor Discharge Pressure	100 psig	100 psig	100 psig	100 psig	NA
Average System Pressure	89 psig	89 psig	89 psig	89 psig	NA
Input Electric Power	522.1 kW	420 kW	511.84 kW	417.26 kW	NA
Operating Hours of Air System	2,080 hrs	2,080 hrs	2,080 hrs	2,520 hrs	8,760 hrs
Specific Power	5.58 cfm/kW	4.96 cfm/kW	5.30 cfm/kW	4.81 cfm/kW	5.14 avg cfm/kW
Electric Cost for Air /Unit of Flow	$26.66/cfm/year	$29.99/cfm/year	$28.09/cfm/year	$37.48/cfm/year	$122.22/cfm/year
Electric Cost for Air /Unit of Pressure	$388.78/psig/year	$312.74/psig/year	$381.13/psig/year	$376.44/psig/year	$1,459.11/psig/year
Ann'l Elec Cost for Compressed Air	$77,755/year	$62,549/year	$76,227/year	$75,287/year	$291,818/year

TABLE 3: PROPOSED COMPRESSOR USE PROFILE

UNIT #	COMPRESSOR: MANUFACTURER/ MODEL	FULL LOAD		ACTUAL ELEC DEMAND		ACTUAL AIR FLOW	
		DEMAND (KW)	AIR FLOW (ACFM)	% OF FULL KW	ACTUAL KW	% OF FULL FLOW	ACTUAL ACFM
First Shift: Operating at 100 psig discharge pressure for 2,080 hours							
1	108 HOS140	81	520	100%	79	100%	520
2	104 DS140	81	520	OFF			
3	104 DS140	84	520	OFF			
4	108B DS140	81	520	OFF			
5	HVAC DSD200	177	992	100%	172		992
6	126E BS60	43	240	OFF			
7	126E BS60	43	240	61%	25	37%	91
8	126E DS140	86	520				
				TOTAL (Actual):	277 kW		1,603 acfm
Second Shift: Operating at 100 psig discharge pressure and 2,080 hours							
1	HVAC DSD200	177	992	90%	155	77%	772
2	108A DS140	81	520	OFF			
				TOTAL (Actual):	155 kW		772 acfm
Third Shift: Operating at 100 psig discharge pressure and 2,080 hours							
1	HVAC DSD200	177	992	100%	172	100%	992
2	108A DS140	81	520	89	70	78	408
				TOTAL (Actual):	243 kW		1,400 acfm
Weekend/Holiday Shift: Operating at 100 psig discharge pressure and 2,520 hours							
1	HVAC DSD200	177	992	85%	146	70%	696
2	108A DS140	81	520	OFF			
				TOTAL (Actual):	146 kW		696 acfm

Proposed Compressed Air System Characteristics

As before with the current system characteristics, the proposed compressor use profile allows us to show the customer what the new system will look like — and the energy savings that will be realized. Providing the customer with the over-all picture, by production shift, allowed the customer to have the confidence to invest in the networked compressor control system needed. Otherwise, the reductions in air demand would not have been translated into energy savings.

TABLE 5: CURRENT AND PROPOSED COMPARISON OF COMPRESSED AIR SYSTEMS

SYSTEM COMPARISON	CURRENT SYSTEM	PROPOSED SYSTEM
Average Flow by Shift 1st/2nd/3rd/weekends	2,916/2,085/ 2,713/2,009 cfm	1,603/772/ 1,400/696 cfm
Avg Compressor Discharge Pressure	100 psig	95 psig
Average System Pressure	89 psig	89 psig
Electric Cost per cfm	$122.23 /cfm/yr	$119.33 /cfm/yr
Electric Cost per psig	$1,459 /psig/yr	$634 /psig/yr
Annual Electric Cost		
Compressor Operation	$291,818	$126,869
Other Air Equipment	$72,441	$18,720
Total Annual Electric Cost	$364,259	$145,589

The benefits to the facility are a compressed air use reduction of 504 scfm translating into a potential energy savings of $70,056 per year.

TABLE 4: CURRENT COMPRESSED AIR SYSTEM CHARACTERISTICS

MEASURE	1ST SHIFT	2ND SHIFT	3RD SHIFT	WEEKENDS/HOLIDAYS	TOTAL
Average System Flow	1,603 cfm	772 cfm	1,400 cfm	696 cfm	NA
Avg Compressor Discharge Pressure	95 psig	95 psig	95 psig	95 psig	NA
Average System Pressure	89 psig	89 psig	89 psig	89 psig	NA
Input Electric Power	277 kW	155 kW	243 kW	146 kW	NA
Operating Hours of Air System	2,080 hrs	2,080 hrs	2,080 hrs	2,520 hrs	8,760 hrs
Specific Power	5.79 cfm/kW	4.98 cfm/kW	5.76 cfm/kW	4.77 cfm/kW	NA
Electric Cost for Air /Unit of Flow	$25.73/cfm/ year	$29.90/cfm/ year	$25.85/cfm/ year	$37.85/cfm/ year	$119.33/cfm/year
Electric Cost for Air /Unit of Pressure	$206.26/psig/year	$115.42/psig/year	$180.94/psig/year	$131.71/psig/year	$634.32/psig/year
Ann'l Elec Cost for Compressed Air	$41,253/year	$23,084/year	$36,189/year	$26,343/year	$126,849/year

Final System Comparison

Customers often appreciate an executive summary. We will often combine the current and proposed system tables into one. Table 5 is an example of the one we supplied to this automotive plant.

Conclusion

The demand-side projects identified include implementing a leak management system, installing automatic shut-off valves on equipment, and addressing inappropriate uses of compressed air. The benefits to the facility are a compressed air use reduction of 504 scfm translating into a potential energy savings of $70,056 per year. BP

For more information please contact Hank Van Ormer, Air Power USA, tel: 740-862-4112, email: hank@airpowerusainc.com, www.airpowerusainc.com

MAINTENANCE SAVES ENERGY

Honda of America Mfg. Fine Tunes Compressed Air System

BY ROD SMITH, COMPRESSED AIR BEST PRACTICES® MAGAZINE

Driving on U.S. Highway 33, northeast of Columbus, Ohio, I scanned the horizon for a glimpse of Honda of America Manufacturing. Surely from the highway, I'd be able to see the famous Marysville and East Liberty facilities — factories that provide jobs for 2,500 and 4,200 employees respectively. I looked forward to seeing these factories whose 2010 production totals reached 340,000 and 246,700 autos. When I reached my East Liberty highway exit, I had still only seen farmland and the lines of mature trees which form those natural wind barriers I'd grown up with in the Midwest.

Honda Green Factories

I had been invited to visit the East Liberty Auto Plant by Mike Seiter, a member of the maintenance staff on the assembly line. He had told me he was a reader of Compressed Air Best Practices® Magazine and that his team had realized some energy savings in their compressed air system. Walking with Mike, in his white work uniform while avoiding silent herds of automatic guided vehicles, I was struck by how quiet and calm the factory floor was — all while Honda CR-V vehicles were being rapidly assembled by people and robots.

Mike Seiter and Mark Hammond (left to right) stand in front of the CR-V production line.

"We are close to becoming a zero-landfill facility. Zero-waste is the goal," Mike explained. Company literature on the Green Factory initiative, coordinated in North America by Karen Heyob, Associate Chief Engineer for Honda of America Mfg., Inc., says the initiative is designed to reduce the impact of Honda's manufacturing operations on the environment. This includes efforts to reduce the energy intensity of production, as well as initiatives to reduce waste generation, air emissions, and water use at all of the company's manufacturing facilities in North America.

The pneumatic limit switch location in the material delivery system.

Advanced Compressed Air Management at East Liberty

I quickly learned that this visit was not about Phase I, Phase II or even Phase X compressed air system improvements! Jim Bayer, the Green Factory Leader at the East Liberty plant explained, "We ran five 1000 horsepower centrifugal air compressors with a 450 hp trim centrifugal when plant production reached its current capacity annual capacity of 240,000 automobiles." Bayer continued, "In 2010, we achieved similar production volumes and we are running only two 1,000 horsepower air compressors with the 450 hp trim centrifugal."

Obviously taking 2,000 horsepower off-line, while at similar production levels, is nothing to sneeze at. Later that evening I used our handy "kWh calculator" on www.airbestpractices.com, to realize that taking 2,000 horsepower off-line equals $816,870 and 13,614,500 kWh of annual savings (I guessed at a motor efficiency factor of 0.96, 8760 working hours per year, and a $0.06 cost per kWh).

MAINTENANCE SAVES ENERGY

Honda of America Mfg. Fine-Tunes Compressed Air System

Honda's East Liberty Auto Plant Quick Facts

Location: East Liberty, Ohio

Started Production: December 1989

Plant Size: 1.9 million square feet

Capital Investment: $1.1 billion

Associates: 2,500

Annual Production Capacity: 240,000 cars & light trucks

Models in Production:

- Element
- CR-V
- Accord Crosstour

Operations:

- Stamping
- Welding
- Painting
- Testing
- Plastics injection molding
- Assembly and sub-assembly
- Quality assurance
- Shipping & export

HONDA
The Power of Dreams

How was this accomplished? "Like with all of our processes, we have continually improved our compressed air system over the years", said Mark Hammond, also part of the Assembly Maintenance Staff at East Liberty. "We went to a Bay Controls compressed air management system in 2002 and upgraded to their newest version in 2009."

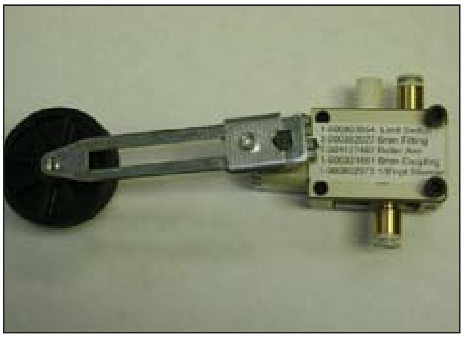
The team went on to describe how they have established kWh budgets (related to compressed air) for each production area in the plant. Impressed because most plants don't do this, but cynically thinking I'd catch the guys with backing into these numbers I asked, "How do you know how much air the Assembly area is using?" The quick reply went like this, "We installed thermal mass flow meters to measure actual compressed air flow to the Assembly area and to all other zones of the facility. The measurement of compressed air flow, along with power and pressure measurements, displayed on our computers by the Bay Controls management system, has made compressed air another utility we can manage more efficiently."

Continuous Improvement in the Compressed Air System

Over the years, the team has made continuous improvements to eliminate inappropriate uses of compressed air and reducing artificial demand. Plant air pressure has dropped from an average of 135 psig to the present 113 psig. Actions have included going to electric paint mixers with VFD's (vs. pneumatic) and blower-powered feather dusters.

The material delivery systems where the pneumatic limit switches were leaking compressed air.

Compressed air leak detection has also become a standard procedure at East Liberty. Mike Seiter and Mark Hammond stated that they believe in "find and repair" rather than "tag and repair" in their leak management program. "Our coordinator, Randy Rhine, is key in letting us take the initiative on maintenance projects. We made a crash-cart with all the pneumatic fittings required for minor leak repairs and with our ultrasonic leak gun we "find and repair" the leaks at the same time." Mr. Seiter continued, "We have read and heard from others that "tag and repair" leak management programs sometimes don't get past the tagging stage."



Close-up of the multi-component pneumatic limit switch that was found to be leaking compressed air.

Fine Tuning the Demand Side of the Compressed Air System

Now they really had my attention. I've seen a lot of compressed air systems in my career — and only once before had I seen a system this sophisticated (hint-it's another car manufacturer). What improvements had they now made that they called me in to see? Mike Seiter said, "A big part of our job is to always seek continuous improvements, and we found some in the compressed air lines in the CR-V assembly area."

The first opportunity was hiding underneath the material delivery systems in the assembly area. Each unit has a pneumatic cylinder actuated by a pneumatic limit switch. Located in multiple locations, these small brass switches were leaking 81 cfm of compressed air. "We went to a one-piece limit switch assembly which costs $64 per unit (vs. $268 for the prior unit) and eliminated $8,000.00 per year of compressed air leaks. This "small" action has reduced our cost per car by five cents."

The second energy-saving action was on the robotic arms gyrating all around the CR-V's on the assembly line. The robots (sorry for the name I'm giving them) is to pick up and mount the front and back windshields on the car. Vacuum pumps give suction cups the strength to pick up the glass components and quickly and firmly put them into place. Working together with the vendor, Mike Seiter explained, "PIAB has reduced the compressed air consumption of the vacuum pumps and we have upgraded the systems. The ROI of the project is calculated at 10.4 months."

Conclusion

Sometimes you walk away from certain people or companies really impressed and feeling good about having been somewhere cool. This was one of those days for me. The common thread of most compressed air systems is that most of them are a disastrous combination of leaks and pressure drops out in the "Dirty Thirty" last thirty yards of pipe before the end use machinery. Not so with the maintenance staff at the Honda plant in East Liberty. They are fine-tuning an already optimized compressed air system. Congratulations, Honda of America Mfg., for an amazing compressed air system. It's clear to me that an operation this efficient will continue to employ thousands of Ohioans in the future! BP

For more information please contact Rod Smith at Compressed Air Best Practices® Magazine, tel: 412-980-9901, email: rod@airbestpractices.com, www.airbestpractices.com

Compact Kars Converts to Waterborne Paints

New EPA 6H Paint Standard Drives Hydrovane Compressed Air Upgrade

BY ROD SMITH, COMPRESSED AIR BEST PRACTICES® MAGAZINE

Compact Kars, Inc. is a Certified Mercedes Benz Collision Repair Center based in Clarksburg, New Jersey.

Tom Elder, President of Compact Kars, Inc.

Exceeding Expectations

Compact Kars, Inc. is a Certified Mercedes Benz Collision Repair Center based in Clarksburg, New Jersey. Launched in 1975, Compact Kars has grown to employ over twenty people in their 24,000 square-foot, 39-bay facility. "The shop has been repairing Mercedes Benz automobiles since 1984, and we are very proud of our reputation and spare no expense to exceed customer needs," says Tom Elder, the Founder and President of Compact Kars.

Mercedes Benz conducts a yearly audit to ensure their rigorous certification requirements are met. This includes owning Mercedes Benz factory-approved equipment, meeting training requirements for employees, and conducting environmentally-friendly business practices. "The Mercedes Benz creed is to exceed expectations," stated Mr. Elder, "When a customer purchases a Mercedes Benz, there is a level of expectation that will not be compromised. This includes complying with the latest EPA VOC Paint Standards."

The New U.S. EPA 6H VOC Paint Standard

The U.S. EPA (Environmental Protection Agency) has issued the National Emission Standard for Hazardous Air Pollutants, NESHAP (Subpart HHHHHH) Final Rule[i]. This "6H" Standard focuses on controlling air emissions from paint stripping and surface coating operations. The compliance deadline, for the new 6H standard, is January 10, 2011.

Collision repair centers, who spray-paint cars, have historically used paints and solvents with the following Volatile Organic Compounds (VOC) and Hazardous Air Pollutants (HAP)[ii].

- Diisocyanates — the leading cause of occupational asthma
- Organic Solvents such as toluene and ethylbenzene have been lined to numerous health effects
- Heavy metals, such as hexavalent chromium, which causes lung cancer; and lead which has been linked to nerve and brain damage

New Waterborne Paints Reduce VOC's Significantly

The new paint specification, for Mercedes Benz Collison Repair Centers like Compact Kars, is for waterborne paints. "The new waterborne paints contain only two pounds of volatile organic compounds (VOC) compared to 5.65 pounds per gallon of VOC's present in solvent-based paints," according to Mr. Elder. "For this reason, Mercedes Benz is asking all certified facilities to convert to waterborne paints."

The Glasurit 90 Line Waterborne Paint is Often Used for Mercedes Benz Vehicles

According to Mr. Elder, Mercedes Benz has tested all the replacement waterborne paints. "Often, the Glasurit 90 Line is the factory OEM-specified paint." Information from Glasurit explains that the 90 Line makes conversion "easier". For example, the aqueous mixing base and the pigmented base are easy to homogenize with its' 2:1 mixing ratio. Glasurit says the 90 Line also uses standard HVLP (high-volume low-pressure) spraying techniques used in the industry. Other favorable factors include shorter flash-off intervals and shorter dwell time in the booth — compared to other waterborne paints[iii].

Mr. Elder is a past president and continues to be very active in the Alliance of Automotive Service Providers of New Jersey (AASP/NJ). He is also the Chairman of the board of Auto Body Distributing, New Jersey's buying co-op for collision repairers. This alliance helps members make the transition to waterborne paints through a buying group and also provides best practice education. A recent initiative by the AASP/NJ has been to join the New Jersey Green Automotive Repair Program (NJGARP).

COMPACT KARS CONVERTS TO WATERBORNE PAINTS

New EPA 6H Paint Standard Drives Hydrovane Compressed Air Upgrade

The NJGARP, launched in April 2009, encourages automotive repair facilities in New Jersey to implement environmentally-friendly business practices and become certified as "green" businesses. Mr. Elder said, "We have developed the guidelines for a green body shop. You qualify by accumulating 450 points and converting to waterborne low VOC can assist a shop in accumulating additional points towards this goal."

Compact Kars converted to waterborne paints and during the transition experienced some extra costs. "We have invested in HVLP spray guns for the waterbased paints and now have two paint recycling systems — one for waterbased and another one for solvent-based paints," said Mr. Elder. "We also have new paint mixing processes to learn and have had to upgrade the compressed air system."

Waterborne Paints: Two Impacts on the Compressed Air System

Compressed air is a critical power source in a collision repair center. If the compressed air system is down or working inappropriately, work will grind to a halt. "I consider compressed air to be the life-blood of a collision center," said Mr. Elder. "I always find it ironic that a $18 million dollar collision repair center often has an antiquated 7.5 horsepower reciprocating air compressor located in a closet in the back of their parts department. Equally bad is the use of rudimentary air treatment products like the single-cannister desiccant dryers found at the point-of-use." The conversion to waterborne paints forced Compact Kars to look at two factors in their compressed air system: increased air demand and higher air quality requirements.

Increased Compressed Air Demand

Paint booths, in collision repair centers, can consume a significant percentage of total shop compressed air demand. This percentage has increased as the base coat of waterborne paints takes longer to evaporate and more compressed air is needed to speed up the drying process. "We use vortex dryers to reduce the booth time of a piece painted with waterborne paints. We have one or two compressed air hoses wide open when drying," said Mr. Elder. "Our air compressor couldn't keep up, particularly on hot, humid days and we asked Brian Keelen, from Air & Gas Technologies, to come take a look at providing a solution."

Air & Gas Technologies is a compressed air sales and service company based in Cliffwood Beach, New Jersey. "After analyzing air demand, we found that the paint booths were now consuming 60% of the compressed air and that shop pressure would fall when the vortex dryers were running," said Mr. Keelen from Air & Gas. "We already had centralized and secondary compressed air storage in place to reduce the

The new Hydrovane HV07RS regulated-speed air compressor at Compact Kars.

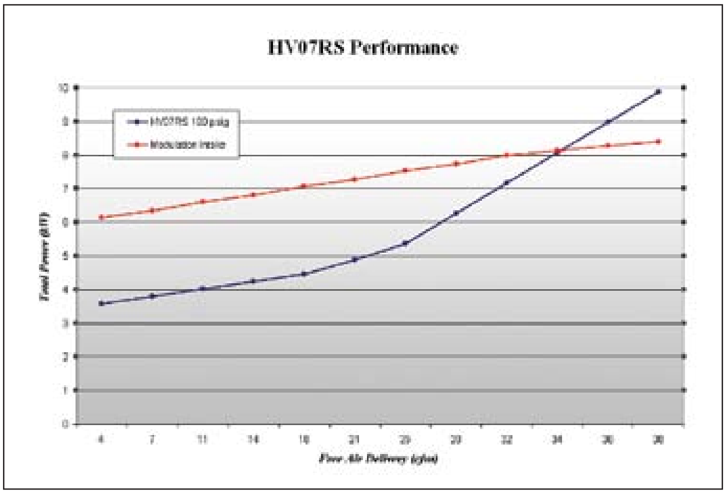
COMPACT KARS CONVERTS TO WATERBORNE PAINTS

New EPA 6H Paint Standard Drives Hydrovane Compressed Air Upgrade

Air & Gas Technologies, Inc.

Air & Gas Technologies, Inc. has provided, since 1995, product, parts, service and complete installations of compressed air and process gas compressor systems. Expertise and experience includes high pressure breathing air compressors used for both SCBA & SCUBA applications and the design/build and maintenance of Compressed Natural Gas (CNG) Refueling Station infrastructure. For more info visit www.airgastech.com

Air & Gas Technologies has extensive experience designing, building, and maintaining Compressed Natural Gas (CNG) Refueling Station Infrastructure



The regulated-speed Hydrovane HV07RS model uses less energy, under partial load conditions, than do typical modulation-intake air compressors.

Vortex Dryers Speed Up the Drying Process

Compact Kars Specializes in Mercedes Benz, Honda, and Volkswagen Automobiles.

impact of the intermittent demand — the shop simply needed more air flow and the ability to turn-down when the vortex dryers were not running."

The decision was made to install a ten horsepower Hydrovane rotary vane air compressor with RS regulated-speed controls. "The installation technician from Air & Gas was outstanding", said Mr. Elder. "He told us how the Hydrovane's on-board computer works and set up how to stage our air compressors." The new Hydrovane acts as the base-load air compressor now and the older rotary screw compressor acts as the back-up.

The new 10 horsepower Hydrovane rotary vane air compressor runs at only 1750 revolutions-per-minute (RPM). This compares very favorably to male rotor speeds of rotary screw compressors ranging from 2,500 to 9,000 RPM. The lower rotating speeds of the rotary vane compressor design mean longer bearing and airend life.

The fact that the enclosed Hydrovane is very quiet is not lost on the employees at Compact Kars, Inc. "The rotary vane air compressor has a 66 dba rating and we have also installed ducting to evacuate the heat in the summer and to use it in the winter," said Mr. Keelen. Mr. Elder continued, "We purchased the extended warranty and use the new synthetic oils that can last a full year. This way we know we will have worry-free operation with one major maintenance per year."

Higher Air Quality Requirements

With a career in collision repair that started in the late 1960's, Mr. Elder has seen quite an evolution with compressed air systems. "I remember we couldn't hear each other whenever the old 5 horsepower tank-mounted, 'iron lung' reciprocating air compressor turned on. So, I enclosed it with a plywood cabinet to reduce the noise — this just made it run hotter and worse." Mr. Elder continued, "Finally, I placed it outside the building — with no air dryer of course. The result was fish-eye paint problems on cold days and on hot days — a machine that couldn't keep up with air demand and that used a lot of oil. Quality compressed air is the life-blood of our facility — making possible our polishing and sanding, cleaning, assembly, disassembly, tire-mounting, and painting processes."

Mercedes Benz Collision Repair Centers must have systems providing clean, dry compressed air containing no moisture, solid particulates, or oil. The use of waterborne paints has accentuated the importance of this specification. "With the intermittent demand profile here, we installed a cycling refrigerated air dryer," said Mr. Keelen. "This allows for a steady 38 ˚F pressure dewpoint and energy-savings as the refrigeration compressor cycles on and off with the intermittent compressed air demands from the paint booths." Coalescing filters have also been installed to remove solid particulates and oil from the compressed air system.

Conclusion

The U.S. EPA (Environmental Protection Agency) has issued the National Emission Standard for Hazardous Air Pollutants, NESHAP (Subpart HHHHHH) Final Rule. This "6H" Standard focuses on controlling air emissions from paint stripping and surface coating operations. Moving to waterborne paints provides benefits to the work and global environment. Compact Kars, led by Mr. Tom Elder, is embracing this change and has made investments to make this possible. One investment has included upgrading the compressed air system to meet higher demand and air quality requirements. BP

For more information, please contact Mr. Brian Keelen, Air & Gas Technologies, 42 Industrial Drive, Cliffwood Beach, NJ 07735, tel: 732-566-7227, email: bkeelen@airgastech.com, www.airgastech.com

i Source: National Emission Standards for Hazardous Air Pollutants NESHAP (Subpart HHHHHH): http://www.epa.gov/ttn/atw/area/arearules.html

ii Source: "Design for the Environment, Automotive Refinishing Partnership". http://www.epa.gov/dfe/pubs/projects/auto/

iii http://www.glasurit.com/en_UK/Products/PassengerCars/90Line.xml

A VIEW FROM EUROPE

Challenge Convention: Compressor Management Systems Applied in the Automotive Industry

BY NICOLAS DE DEKEN, ENERGAIR

"There is a comfort factor with familiar technology, which is exacerbated by constant time pressure due to other day-to-day responsibilities and a lack of information and good advice on what can be achieved."

— Peter Tomlins, a compressor control specialist at EnergAir

Whether the government sanctioned energy price rises are driven by European politics, genuine environmental concern or just plain profiteering is open to question. The impact, however, on the financial viability of industry is clear; costs are rising and changes will have to be made in order to remain competitive.

Most plant personnel with responsibility for improving plant efficiency will know that compressed air is one of the areas where savings can be made, but making changes is not always an easy or comfortable process. According to Peter Tomlins, a compressor control specialist at EnergAir, it is essential that people in this position challenge convention in order to make the right decisions and ensure that potential savings are actually realised. "First there are the old conventions. The majority of compressor houses still employ fixed speed

compressors and a cascaded pressure switch control system. This arrangement will be familiar to many, but it is outdated and inefficient, and needs to be changed. There is a comfort factor with familiar technology, which is exacerbated by constant time pressure due to other day-to-day responsibilities and a lack of information and good advice on what can be achieved."

Mr. Tomlins continued, "Secondly there are new conventions forming that are little better, and can be misleading. Operators are receiving mixed messages from the compressor manufacturers themselves, while most branded air compressors

A VIEW FROM EUROPE:

Challenge Convention: Compressor Management Systems Applied in the Automotive Industry

are good machines, an incorrectly sized new compressor can have a negative effect on overall system efficiency.

The current trend towards buying variable speed drive (VSD) compressors does offer the potential to generate compressed air more efficiently, but a VSD compressor that is not controlled as part of a coherent compressor management system that can optimize it's use alongside other compressors in a system is unlikely to deliver any energy savings whatsoever, or worse still, could contribute to a deterioration in overall system efficiency."

These conventions, old and new, have to be challenged if the operator is going to see real benefits. If an old cascade pressure switch control system does have to be replaced,

EnergAir CASE STUDY: EnergAir Compressed Air Management System Saves Car Maker £30,000 P/A In Energy Costs

An EnergAir compressed air management and communication system installed at a UK car plant has achieved an impressive 17% reduction in energy usage. The efficiency gains were made by close control of compressor speed and system pressure including the use of a retrofit variable speed drive. The project has reduced the electricity bill by well over £30k per annum and achieved a capital payback period of a matter of months. Other benefits include increased monitoring visibility and hence improved compressed air service support.

Manufacturing output at the plant totalled over 200,000 vehicles last year working 24/7. Prior to the installation of the EnergAir management system, the energy bill for compressed air was around £350,000 per annum and the facilities team were looking for ways to reduce it. The idea of installing an EnergAir system was put forward by local compressed air service supplier Oscott air.

Oscott saw the potential for a significant reduction in energy usage and improve their service using the detailed real-time feedback on system status to enable them to react quickly to potential problems before they arose.

Energy savings were achieved in two ways. Firstly, the plant's seven 160 kW fixed-speed screw compressors were transferred from a basic pressure band operated cascade control system to a more sensitive and accurate EnergAir Enercon system controller. The maximum generating/system pressure could then be reduced from 9.1 to 8.4 bar, the pressure reduction did not effecting the performance of any air operated equipment within the plant and resulted in a 9% saving in direct electrical energy costs. The saving is equivalent to £31,500/annum and has been fully audited.

The second method was to connect a retrofit variable speed drive to one compressor and integrate it into the control system. This was installed later on and is set to reduce the energy costs by a further 8% by eliminating in excess of 90% off-load running and effectively maintain a narrower pressure band of between 7.9 and 8.1 bar. The drive enables the system controller to run six of the compressors at their most efficient speed and use the VSD controlled unit to finely balance system pressure. Off-load running refers to compressors running unnecessarily to maintain system pressure when there is no actual demand.

Monitoring is a key element

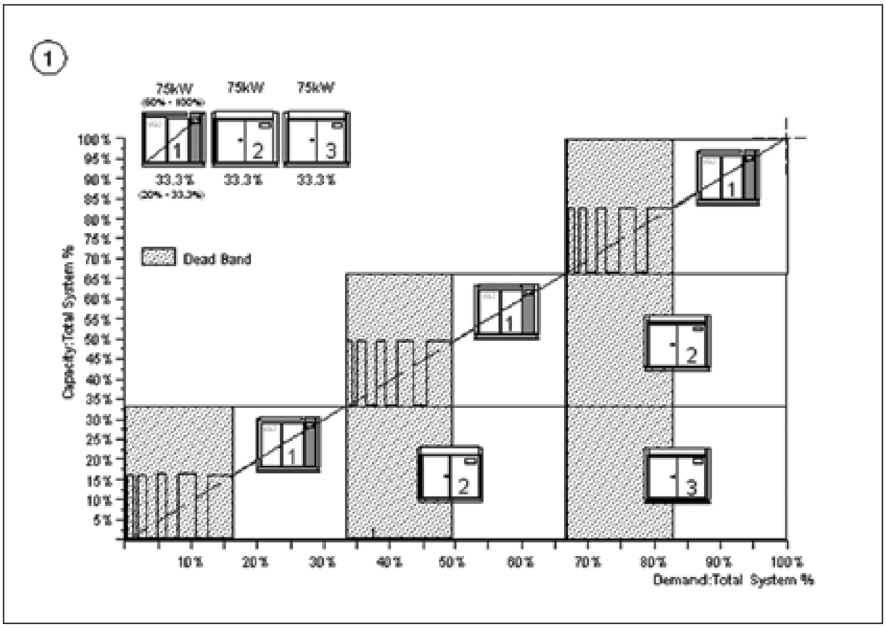
As compressed air is an integral part of the whole 24/7 production cycle, the challenge for the compressed air service supplier is to achieve an uninterrupted air supply.

The EnergAir system has helped achieved this using the EnergAir 'alert' automatic early warning system combined with real-time monitoring and remote interrogation.

(Continued on page 34.)

A VIEW FROM EUROPE:

Challenge Convention: Compressor Management Systems Applied in the Automotive Industry



don't assume a new compressor will solve your problems. Where new compressors are required, pay close attention to compressor sizing and in particular to the relationship between individual compressor output and the variation this provides when taken together and compared to compressed air consumption patterns.

It is important not to assume that a VSD compressor alone will solve all your problems. The big energy saving claims of circa 30%, from some compressor vendors relate to the comparison of a single fixed-speed compressor with a single VSD equivalent. This may not apply to how this compressor will perform in a multi compressor house environment. It has to be integrated with existing compressors under

EnergAir CASE STUDY: EnergAir Compressed Air Management System Saves Car Maker £30,000 P/A In Energy Costs *(continued)*

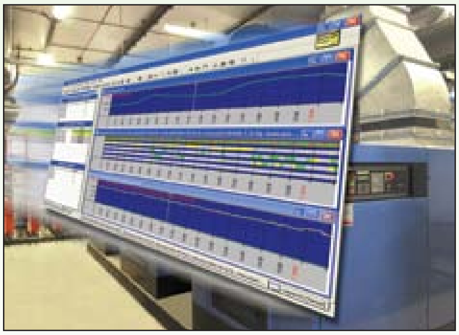
The monitoring facilities integrated into the system include: energy usage, system efficiency, compressor status, compressor bearing condition, compressor water coolant temperature, dew point analysis, room temperature, air filter status and air discharge pressure to the system.

Monitoring to this depth provides both a highly accurate measurement of system performance over time and the detailed real-time feedback needed to activate EnergAir's alert software. Threshold levels, dictated by experience and system demands are set in the alert software for all relevant operating parameters. A time or frequency buffer is set and if any part

of the system runs over the threshold, an alarm is tripped. Alarms are categorised due to their seriousness and an automatic warning is generated. Messages are tiered and relayed via modem to from faxes, emails or text messages. Response thresholds are set and in a potential emergency the system will follow a sequenced contact pattern until it gets a response 24/7.

The alert system then allows Oscott to interrogate the EnergAir system either prompted by an alert message or as a routine check from their local office and react accordingly. This has reduced the number of callouts and improved response times because the supplier is aware of a potential problem before it has chance to develop and is fully briefed before an onsite visit is made.

Other benefits include compressors running for a reduced number of hours and so extending their life and service intervals. Condition monitoring of dryers and filters allows them to be replaced only when needed, optimising process reliability and performance data also assists the manufacturer with permanent



auditing for continual improvement/assessment of the whole compressed air system.

Companies can contact EnergAir for a preliminary site survey and receive an estimate on the amount of energy that can be saved before embarking on a full site audit or installing EnergAir equipment. A full audit provides highly accurate information on system efficiency, performance and potential energy savings. Using this information, EnergAir are able to recommend the most effective solution to compressor control on site and provide an accurate estimate for the payback period.

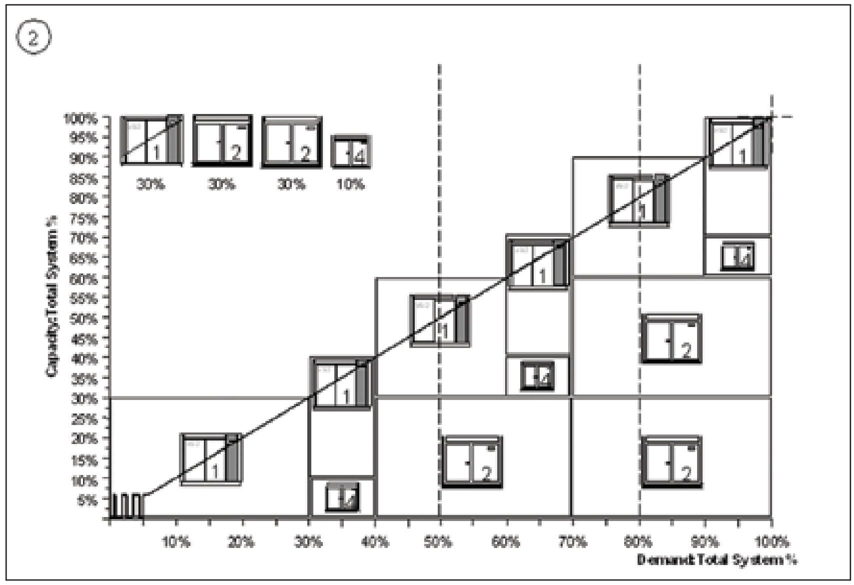
some form of management control in order to deliver significant savings.

If you have enough compressors already, consider retrofitting a VSD to an existing compressor rather than making another compressor purchase. A retrofit VSD, from a specialist such as EnergAir, will be cheaper to buy, cheaper to install and make better use of the existing equipment.

Peter Tomlins adds, "When selecting VSD compressors, users should pay close attention to its minimum speed as well as maximum speed. Its output span, efficiency across its output span and the inverter reaction time are also considerations. EnergAir sees a lot of examples of VSD compressors with relatively slow reaction times. The result is a compressor that's simply incapable of reacting effectively to fluctuations in demand patterns.

Other conventions about sizing compressors can also have a big impact on system efficiency. Air demand tends to be erratic. If you follow shift patterns and in some cases even seasonal trends, we've seen literally hundreds of sites where the demand for compressed air often falls in between the generating capacity of available compressors. This leads to increases in 'off load' running in the case of fixed speed compressors, which is inefficient, and where VSD compressors are installed hunting or 'dead banding' can occur.

Example 1 is a typical compressor system of 3 equally sized compressors. A conventional lead, top up and standby compressor arrangement and in recent times, one of the compressors is likely to be a VSD compressor. Conventional thinking is that the VSD compressor will satisfy primary demand. When demand increases above one compressor, a fixed speed compressor is loaded. The VSD compressor



A VIEW FROM EUROPE:

Challenge Convention: Compressor Management Systems Applied in the Automotive Industry

reacts accordingly by reducing its output to satisfy demand above that which the fixed speed compressor is now delivering. However, if demand for compressed air falls between 100% and 150%, then 'deadbanding' will occur where the VSD compressor cannot regulate down to a speed proportional to demand. Further to that, what intelligence is going to make the decision about which compressor to run and when?

Old conventions are to choose multiple compressors of the same size in a compressor house. New convention is to choose machines of the same size and make one a VSD compressor. To Challenge convention would be to consider **Example 2**. Here, instead of three equally sized compressors, a fourth smaller compressor has been added. Like new convention, one of the three equally sized compressors is a VSD. However, note how dead-banding has all but been eliminated through the introduction of an alternative size of compressor. Here supply and demand can be satisfied across the entire demand spectrum. Orchestrating it would be Management Technology such as that offered by EnergAir.

EnergAir CASE STUDY: Delphi Diesel Systems Opt For EnergAir Compressed Air Management System And Save £20,000 Per Annum Energy Costs.

The services supply team at Delphi Automotive Systems in Sudbury challenged EnergAir solutions Ltd. to demonstrate that energy cost savings of £20,000 per annum could be achieved by installing an Enercon compressed air management system. EnergAir did exactly that by monitoring compressed air system performance in detail for two weeks and presenting the results in a qualified report. Twelve months after the system was installed, it had paid for itself and now, twenty months on, it is consistently delivering energy savings on target and also providing other benefits such as reduced compressor usage and data for more accurate maintenance procedures.

Similarly to many other global manufacturing companies, the Delphi group currently has a target of reducing energy consumption at all its major manufacturing sites by 3% each year. The Sudbury plant however, produces diesel engine injection equipment and filters for the worldwide market and runs 24hours 350days a year, due partly to the current growth trend in diesel engine usage.

Peter Vallance, Central Services Manager at Delphi comments that, "Current high production levels meant that we had to reduce energy consumption by working more efficiently. Compressed air represents a significant part of our energy bill and the EnergAir system has given us close to our target 3% savings on electricity simply through more efficient operation".

The site services team at Delphi recognised that the use of variable speed drives (VSDs) would improve compressor efficiency and controllability six years ago when their current air compressors were installed. At the time they could not find a solution on the market that was either proven or cost effective. Two years ago compressor maintenance contractor Anglair suggested that Delphi consider the EnergAir system as it provided VSD control and a host of other system benefits such as reporting performance data and continuous condition monitoring.

Peter Vallance continues, "After an initial meeting, we were interested in EnergAir's ability to show actual savings at a site prior to a system being installed. We laid down the gauntlet and proposed that if they could demonstrate the savings, we would invest". EnergAir did exactly that by fitting equipment at the site to monitor system pressure, power consumption in kW/hours, air production volume in m^3 and efficiency in kW/m^3 for a fortnight.

The results were then collated into a full systems report that detailed the exact savings that could be expected and the methods by which they could be achieved. Peter Vallance states, "We were won over by the detail and accuracy of the initial survey and decided to have the full system installed". There are three 98 kW compressors and three 267 kW units on site, all six machines are now integrated into a control network using a single VSD to fine tune compressor operating speed. The Enercon system controller works with an I/O and a comms box to manage the system using the monitoring equipment that gave the initial report details as a feedback loop.

Control and reporting is done via a PC on-site. The installation took only three days and did not interrupt production in any way.

Conclusion

Rising costs are providing the stimulus to change, and so EnergAir believes that challenging convention should take the form of asking questions about plant equipment and of suppliers: Has the demand profile been mapped? Are the compressors on the site the right combination of sizes? Has energy use been recorded and benchmarked so that the impact of any changes made can be validated? Are multiple compressors being controlled by an effective management system?

Is a new VSD compressor the right solution, and can it's capability for energy savings actually be realized? Finding answers to these questions will involve challenging convention, but it should ensure that the available savings for compressed air generation are actually realized. BP

For more information please contact Nicolas De Deken, tel: 855-289-9317, email: nicolas.de.deken@energair.com, www.energair.com

After twelve months in operation the whole installation from EnergAir paid for itself in savings made from electricity bills.

> Peter Vallance confirms, "We are very impressed with the system overall, it has delivered the savings promised and provides us with a much finer control over the compressor house in general as well as producing accurate reporting of efficiency and performance. That information is passed on to senior management, adding a transparency to the services operation that was previously impossible. The detail of compressor loading has also allowed us to predict and carry out maintenance more effectively and so control costs and avoid downtime".

Nigel Clark, one of EnergAir's Senior Systems Engineers provides more detail on how the results are achieved. "In real terms the EnergAir compressed air management system installed at Delphi reduces compressor energy consumption by closely matching system pressure to demand and reducing off-load running or idling of compressors. The control is implemented in a number of ways depending on the installation, an 'Enercon' management system controller though ensures that all the compressors on any one ring main, regardless of their make, type or capacity, operate cohesively and more importantly, efficiently.

Effective downstream system monitoring is also an essential part of the package. Sensors are fitted at relevant points throughout a system and the recorded data is presented by EnergAir's EnerSoft air management software. EnerSoft displays live information on equipment status and system pressure, while providing accurate metering of power consumption in kW/hours, air production volume in m^3 and efficiency in kW/m^3. EnerSoft can also be used to produce regular performance reports for internal appraisal; the function is a built-in feature of the software and is extremely easy to use.

An added advantage of the monitoring equipment is that it has a series of alert systems built into it; these can be set-up

to trigger multi layer responses both locally and remotely including screen warnings and audible signals, phone calls, texts and fax messages. At Delphi, the 'Alert' system is programmed to provide visual warnings on-site and report to the service contractor Anglair with pre-emptive warnings of problems, emergencies and routine maintenance checks. This includes the air dryers at Delphi that are also linked into the system.

Companies can contact EnergAir for a free preliminary site survey and receive an estimate on the amount of energy that can be saved; should it prove that there is potential for saving energy, EnergAir will now provide a detailed report and offer to guarantee the energy savings.

VSD COMPRESSOR CONTROL

BY RON MARSHALL FOR THE COMPRESSED AIR CHALLENGE©
EDITS BY BILL SCALES

"Compressed air systems, with multiple compressors operating to supply demand requirements present unique challenges in compressed air system control schemes." states "Best Practices for Compressed Air Systems", in an introductory statement dealing with multiple compressor controls. An original, and still common, method of control in multi-compressor systems is to use a cascaded arrangement of set points as shown in Figure 1. This control strategy was discussed in our article in the November, 2010 issue of Compressed Air Best Practices® Magazine. This is the simplest and least expensive method of compressor control, but it suffers from a number of disadvantages:

- Average compressor discharge pressure is always higher than required
- It is difficult to accommodate multiple compressor sizes
- Adequate control is often subject to manual adjustment of pressure switches or manually operating compressors on a time schedule
- It is difficult to keep the most efficient compressor in trim duty

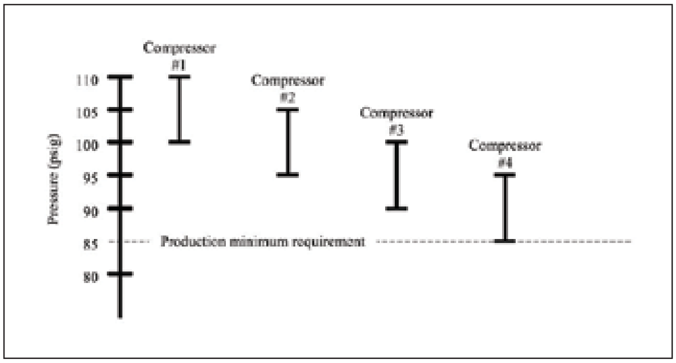


Figure 1- Cascade control should not be used with VSD compressors

This cascaded arrangement assumes each compressor has the same characteristics when running at partial load, very often not the case, especially if one of the compressors is a variable speed drive (VSD) controlled unit.

The most efficient way to run a multi-compressor system is to hold any required fixed speed compressors at either fully loaded or off. The compressor with the most efficient part-load characteristics should run as the trim unit. A trim unit is the one designated to supply part load operation, where the combination of required compressors at any given load requires a fraction of one compressor. A VSD compressor, which by design has good part load energy performance, normally becomes the designated trim compressor.

The selection of the size of this trim compressor and its pressure settings become important when implementing this type of control. If incorrect choices are made there will be "control gap" issues that will cause the system to become unstable, with possibly two or more compressors inefficiently "fighting" for trim position.

Control Gap

If a trim compressor is to be set to always supply partial load, it must have its pressure settings coordinated so a large enough pressure control band is inside, or within, the pressure band of the base compressor as shown in Figure 2. If set in this arrangement, the VSD compressor will control system pressure if it is supplying partial load. If system loading increases to a level exceeding its capacity, the compressor discharge pressure will be reduced to the load (start) setting of the base compressor. The base compressor will then start producing air at full load capacity, pushing the discharge pressure back up to within the control band of the trim compressor. If the load remains above the total capacity of the base compressor, the trim compressor will supply the remainder of the partial load that is above the base compressor capacity.

If the load falls to less than the capacity of the base compressor, the trim compressor will try to maintain pressure by reducing its capacity to zero, but even with this capacity reduction the capacity of the base compressor will force discharge pressure up to the point where it will unload and time off. Once this base capacity is removed from the system, the discharge pressure will fall back down to within the trim compressor's control range, where it will take control again.

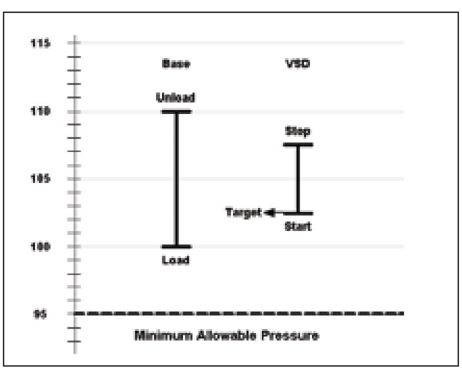


Figure 2- The VSD compressor setpoints within the base control range

Sizing Matters

This efficient control method depends on the correct sizing of the variable trim capacity. Consider an example system where a 75 hp trim compressor with a capacity of 300 cfm and a 100 hp base compressor of 400 cfm capacity are programmed to work together with the arrangement just discussed. Everything works fine if the system loading is between zero and 300 cfm, or between 400 and 700 cfm. But if the loading settles to within 300 and 400 cfm problems occur. This is because a size mismatch creates a 100 cfm wide "control gap" in which neither base nor trim compressor can efficiently supply the load. This control gap is located within the system capacity control scheme at a point representing the difference in the sizes of the compressors and occurs when the trim capacity is less than the base capacity.

In our example system, if loading reaches, say 350 cfm, the trim compressor discharge pressure will fall to the point where the base compressor will start and begin producing air. It will push the pressure up past the control range of the trim compressor where the trim compressor will unload (or stop), however, this removes only 300 cfm, and the base compressor is 400 cfm, so there will still be an excess capacity of 50 cfm, driving the pressure up to the unload point of the base compressor. When the base compressor unloads the pressure will fall to within the control range of the trim compressor, and it will start, but because it has only 300 cfm capacity, and the actual load is 350 cfm, the pressure will continue to fall to the load point of the base compressor. If the load remains stable within the control gap the two compressors will continue to "fight" for trim position, with significantly reduced system efficiency.

One solution to this problem may be to provide a trim compressor that is equal to, or larger, than the base compressor. The duration of the control gap operation is often dependent on the continuous or intermittent system demands. In some instances, the problems associated with the control gap can be reduced by increased storage capacity alone, or in combination with a pressure/flow controller for fixed speed compressors. The Compressed Air Challenge (CAC) recommends a minimum of three (3) gallons of storage capacity for the trim compressor. In this case approximately 1,000 to 1,200 gallons is recommended.

VSD COMPRESSOR CONTROL

VSD Compressor Control Range

VSD compressors are designed to control discharge pressure within a very accurate range while within the compressor's variable speed range. However, VSD compressors can only slow down so much, with the minimum speed point often depending on the characteristics of the compressor. Below the minimum speed point, the compressor acts like a load/unload (or start/stop) controlled compressor with the compressor operating between two set pressure settings. Figure 3 shows a typical compressor control range. Note some compressor manufacturers fix the target pressure at the bottom of the control range, where others allow the target pressure setting to be adjustable to any point within the load/unload range.

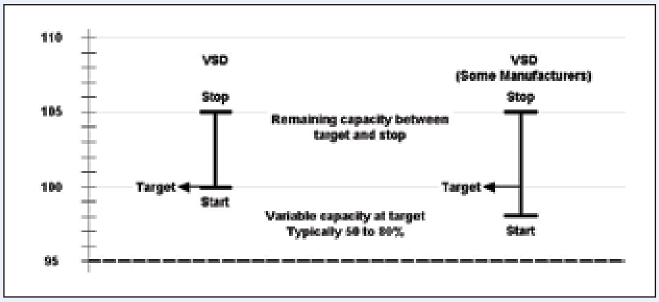


Figure 3 – VSD Control Ranges

Correct Sizing Example

Consider an alternative system with a VSD compressor of 400 cfm capacity and the base compressor of 300 cfm. If the system loading reached 350 cfm the VSD compressor would have more than enough capacity to handle this load. If the system loading increased to say 450 cfm, the system pressure would fall to the load point of the base compressor, as described previously, and the base compressor would load and start to supply 300 cfm. The remaining 150 cfm would then be supplied by the VSD compressor, which would automatically adjust speed to maintain target pressure within its variable range. The system loading would need to fall lower than 300 cfm before the base compressor would force the pressure up so it would unload, passing the full system demand back to the VSD compressor. Because the VSD compressor is larger than the base compressor by 100 cfm, there is a 100 cfm wide overlap band. System loading must increase above 400 cfm to start a base compressor, but must decrease to below 300 cfm to cause the base to unload. This "debounces" system control and prevents the compressors from constantly sequencing for control if the system loading is just skirting the edge of the capacity ranges of the two compressors.

Pressure Control Band Overlap

If the VSD compressor variable capacity range (cfm) is larger than the base compressor's full capacity rating (cfm), the pressure band of the VSD compressor need not be fully inside the load/unload pressure band of the base compressors for efficient operation (Figure 4).

In the previous example, if the 400 cfm compressor had a turn down of 80%, or 320 cfm, this variable capacity range still exceeds the 300 cfm capacity of the base compressor and still provides 20 cfm of overlap capacity. In this case the VSD compressor need not fully unload and turn off during transition between loads requiring the base compressor; it only needs to run at minimum speed. This reduces the need for the VSD to turn off and blow down (if applicable), allowing the unit to start producing air faster when called upon. It will therefore enable a narrower pressure band control between the VSD target pressure and the base compressor load point, reduce the average discharge pressure and save energy.

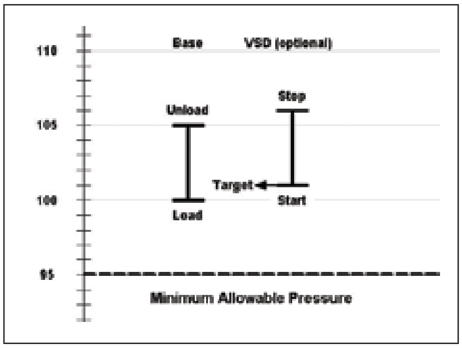


Figure 4- Alternate control range setting if VSD variable range is larger than the base.

VSD and Two or More Base Units

If there are two or more base or VSD compressors operating within a system, the control begins to get even more complicated and special considerations are required. This type of operation is beyond the scope of this article, however, a discussion of this and many others is provided in Appendix 2.A.4 of CAC's "Best Practices for Compressed Air Systems". This 325 page book has excellent reference material and is available at our bookstore. BP

RESOURCES FOR ENERGY ENGINEERS

TRAINING CALENDAR

TITLE	SPONSOR(S)	LOCATION	DATE	INFORMATION
Compressed Air Challenge® Advanced Management of Compressed Air Systems	KPPC	Louisville, KY	3/22/11-3/23/11	www.kpc.org Tel: 502-852-0965 training@kppc.org
Compressed Air Challenge® Fundamentals of Compressed Air Systems	Sacramento Municipal Utility District	Sacramento, CA	4/7/11	Paul Gillaspy Tel: 916-732-5375 pgillas@smud.org
Compressed Air Challenge® Fundamentals of Compressed Air Systems	ProtoGen Group	Kettering, OH	4/15/11	Ray Lepore Tel: 937-216-9452 ray.lepore@fastmail.fm
Compressed Air Challenge® Fundamentals of Compressed Air Systems	Hughes Machinery Atlas Copco Omaha Public Power	Omaha, NE	4/26/11	Dennis Tribbie Tel: 402-571-5004 dtribbie@hughesmachinery.com
Compressed Air Challenge® Advanced Management of Compressed Air Systems	Hughes Machinery Atlas Copco Omaha Public Power	Omaha, NE	4/27/11–4/28/11	Dennis Tribbie Tel: 402-571-5004 dtribbie@hughesmachinery.com

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

PRODUCTS

Rectangular Vacuum Cups Handle Long And Narrow Loads

A new line of rectangular vacuum cups that are designed for handling high capacity loads with inadequate surface areas for gripping is being introduced by Anver Corporation. Anver Rectangular Vacuum Cups for handling narrow loads feature NBR rubber bonded onto a machined aluminum hub and include an internal safety seal for a sure grip. Designed for long, narrow, heavy loads that cannot be lifted using conventional cups, they are rated at up to 550 lb. horizontal each. Ideally suited for lifting I-beams, girders, reinforced boards, and architectural panels, Anver Rectangular Vacuum Cups are offered in five sizes ranging from 4"–7" W by 11"–20" L and each include pre-drilled and tapped mounting holes and a vacuum port. Anver Rectangular Vacuum Cups are priced from $49.95 up, depending upon size. Pricing is available upon request.

Anver Corporation
Tel: 1-800-654-3500
e-mail: mlaycox@anver.com
www.anver.com

RESOURCES FOR ENERGY ENGINEERS

PRODUCTS

New Schulz Compact Rotary Screws

Schulz announced the arrival of the new 3015 & 3020 Compact Series of rotary screw air compressors. There are 15 hp and 25 hp models with a simple open design. Maximum working pressure is 125 psi and electrical specs are 208-230 volt. The product line has one solenoid for load and unload operation and analog controls.

Schulz Compressors
Tel: 770-529-4731
www.schulzamerica.com

Ultrachem Certified To Russian GOST-R Requirements For Industrial And Food Grade Applications

Ultrachem, Inc. has received obligatory certification that the company's synthetic lubricants, oils and greases meet the requirements of Russian GOST-R for use in Industrial and Food Grade applications. Certification to the Russian GOST-R quality standard is essential for products to enter into the Russian Federation and to be sold in Russia. Compliance to GOST-R also assures that the goods delivered in Russia, and/or the production line where they were manufactured, conform to the Russian Safety Standards. "With GOST-R certification, Ultrachem is well-positioned to deliver our product technology and customer support to manufacturers of industrial and food-grade goods in Russia," said Bob Whiting, president of Ultrachem. "This is a significant first-step to expanding our reach throughout Eastern Europe." Ultrachem recently opened a sales office in Moscow to support anticipated increased participation in the Russian market for synthetic lubricants. Ultrachem currently exports ultra-premium synthetic lubricants to more than 25 countries worldwide. For more information on GOST-R, visit www.gost-r.info.

Ultrachem Inc.
Tel: 1-302-325-9880
E-mail: info@ultracheminc.com
www.ultracheminc.com

More Choices Mean Greater Utility

To suit a wider variety of installation requirements, the Ashcroft® G2 pressure transducer is now available with a larger selection of electrical and pressure connections. Deutsch DT and DTM along with the AMP Superseal 1.5 connection provide moisture resistance along with proven latch designs that prevent inadvertent disconnection. New pressure ports include the SAE O-ring connection in various sizes and the SAE UNJF-3A 37° flare cone fitting in 3/8"- 24. The rugged G2 transducer offers exceptional stability along with 1% TEB accuracy over a broad temperature range.

Ashcroft Inc.
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www.ashcroft.com

RESOURCES FOR ENERGY ENGINEERS

PRODUCTS

Long Static Eliminator Neutralizes And Cleans Wide Surfaces

EXAIR's new Long Super Ion Air Knives neutralize static electricity while blowing away dust and particulates from printed surfaces, paper, plastics and three dimensional shapes up to 96" (2438mm) across. The wide laminar airstream full of static eliminating ions is effective at high speeds and provides superior cleaning up to 20 feet away. Poor print quality, dust attraction, tearing, jamming, and related equipment downtime can be eliminated.

The Long Super Ion Air Knife is highly efficient, using only a minimal amount of compressed air at 5 psig to entrain high volumes of surrounding room air. An electrically powered static control bar fills the uniform sheet of air with a high concentration of positive and negative ions. The laminar airstream increases the surface exposure to the ions, making it effective for high speed processes and over long distances. Force can be adjusted from a "blast" to a "breeze". The shockless design is UL Component Recognized to US and Canadian safety standards. There are no moving parts to wear out.

Long Super Ion Air Knives are available in 60" (1524mm), 72" (1829mm), 84" (2134mm) and 96" (2438mm) lengths that are fully assembled. A factory installed plumbing kit is also available that makes it easy to connect Long Super Ion Air Knives to any plant's compressed air system and obtain the best performance. Prices start at $1,739.

EXAIR Corporation
Phone: (800) 903-9247
Email: techelp@exair.com
www.exair.com/lsiak.htm

Hydrovane Rotary Vane Compressors To 60 hp

Hydrovane rotary vane compressors are air-cooled and oil flooded, available from 2-60 hp with a standard TEFC motor. Direct drive operation with no belts or gears results in less parts to maintain or repair. Hydrovane operates at a slow speed of 1760RPM, providing low stress, low noise levels, and superior reliability. Hydrovane offers a flexible range of unenclosed and enclosed fixed speed units, base or tank mounted, with a variable speed selection from 10-60 hp. Extremely small package footprint makes Hydrovane easy to install and accessible even in restricted areas. An optional Platinum 10 year warranty ensures worry-free operation of this powerful, cost effective, and versatile industrial air solution.

Hydrovane Compressors
www.hydrovaneproducts.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 during the trading day of February 23, 2010.

DECEMBER 27, 2010 PRICE PERFORMANCE	SYMBOL	OPEN PRICE	1 MONTH	6 MONTHS	12 MONTHS	DIVIDEND (ANNUAL YIELD) 12 MONTHS
Parker-Hannifin	PH	$87.23	$86.03	$59.56	$58.72	1.44%
Ingersoll Rand	IR	$44.84	$45.37	$33.23	$33.02	0.61%
Gardner Denver	GDI	$70.99	$70.40	$47.01	$42.34	0.28%
Atlas Copco ADR	ATLCY	$21.43	$21.12	$13.05	$12.72	1.80%
United Technologies	UTX	$82.79	$80.26	$65.51	$68.38	2.03%
Donaldson	DCI	$55.03	$58.42	$42.10	$41.39	0.91%
SPX Corp	SPW	$78.70	$74.43	$56.60	$61.14	1.25%

SPX Reports 4th Quarter 2010 Earnings

SPX Corporation (NYSE: SPW) reported results for the fourth quarter and year ended December 31, 2010:

Fourth Quarter Highlights:

- Revenues of $1.33 billion increased slightly from $1.32 billion in the year-ago quarter. Organic revenues declined 3.0%, while completed acquisitions and currency fluctuations impacted revenues by 4.4% and (1.3)%, respectively
- Segment income and margins were $160.4 million and 12.1%, compared with $168.9 million and 12.8% in the year-ago quarter
- Diluted net income per share from continuing operations was $1.30, compared with a loss of $1.62 in the year-ago quarter. The fourth quarter 2010 results include a tax benefit of $8.6 million, or $0.17 per share, associated with the settlement of certain legacy tax matters
- Adjusted net income per share from continuing operations, which excludes the impact of the tax benefit noted above, was $1.13, compared to the company's guidance of $0.95 to $1.10
- Net cash from continuing operations was $213.6 million, compared with $226.2 million in the year-ago quarter. The decline in cash flow was due primarily to a voluntary pension contribution of $100 million in the fourth quarter of 2010. This was partially offset by other changes in working capital and lower cash spending on restructuring
- Free cash flow from continuing operations during the quarter was $173.6 million, compared with $193.1 million in the year-ago quarter. The decrease was due primarily to the items noted above, in addition to higher capital expenditures

WALL STREET WATCH

Full Year 2010 Highlights:

- Revenues increased 0.9% to $4.89 billion from $4.85 billion in 2009. Organic revenues declined 2.4%, while completed acquisitions and currency fluctuations impacted reported revenues by 3.8% and (0.5)%, respectively
- Segment income and margins were $560.3 million and 11.5%, compared with $587.8 million and 12.1% in 2009
- Diluted net income per share from continuing operations was $3.86, compared with $0.95 in 2009. The full year 2010 results include net tax benefits of $28.6 million, or $0.57 per share, associated with the settlement of certain tax matters and charges of $25.6 million, or $0.33 per share, associated with the early termination of debt and related interest rate swap agreements
- Adjusted net income per share from continuing operations was $3.62, excluding the items noted above, as compared to the company's guidance of $3.45 to $3.60
- Net cash from continuing operations was $256.7 million, compared with $463.2 million in 2009. The current year net cash from continuing operations included cash usage of $24.5 million for the early termination of debt and associated interest rate swap agreements. The remaining decline in cash flow was due primarily to the fourth quarter 2010 pension contribution and investments in working capital, particularly accounts receivable, as a result of organic growth in the second half of 2010. This was partially offset by lower cash spending on restructuring
- Adjusted free cash flow from continuing operations for 2010, which excludes the cash paid in connection with the early debt termination noted above, was $205.5 million, compared with free cash flow of $370.4 million in 2009

"We are pleased with our 2010 results as we have met or exceeded all the consolidated financial expectations we set at the beginning of the year and made progress towards our long term goals," said Christopher J. Kearney, Chairman, President and Chief Executive Officer of SPX. "We are in a strong financial position with sufficient flexibility to continue to make strategic investments as opportunities arise. "As we move into 2011 we are encouraged by many positive trends across our end markets, and remain confident in, and committed to executing, our long term strategy," Kearney added.

Financial Highlights — Continuing Operations

Flow Technology

Revenues for the fourth quarter of 2010 were $486.2 million compared to $437.9 million in the fourth quarter of 2009, an increase of $48.3 million, or 11.0%. Organic revenues increased 2.8%. The 2010 acquisitions of Anhydro and Gerstenberg Schroeder increased reported revenue by 9.2%, while the impact of currency fluctuations decreased revenues by 1.0% from the year-ago quarter.

Segment income was $70.9 million, or 14.6% of revenues, in the fourth quarter of 2010 compared to $62.7 million, or 14.3% of revenues, in the fourth quarter of 2009. The increase in segment income was due primarily to the contributions of the 2010 acquisitions of Anhydro and Gerstenberg. Segment income and margin also benefited from positive product mix and leverage on the organic growth compared to the year-ago quarter. However, the segment margin improvement was partially offset by 50 basis points of dilution from the acquisitions.

Test and Measurement

Revenues for the fourth quarter of 2010 were $252.1 million compared to $219.2 million in the fourth quarter of 2009, an increase of $32.9 million, or 15.0%. Organic revenues increased 17.4%, driven primarily by increased sales of diagnostic and service tools to vehicle manufacturers and their dealer service networks. The impact of currency fluctuations decreased revenues by 2.4% from the year-ago quarter. Segment income was $21.7 million, or 8.6% of revenues, in the fourth quarter of 2010 compared to $19.4 million, or 8.9% of revenues, in the fourth quarter of 2009. The increase in segment income was due primarily to the impact of the organic revenue increase noted above. The positive impact of the organic growth on segment margin was more than offset by a lower LIFO adjustment in the fourth quarter of 2010 as compared to the fourth quarter of 2009. Excluding the impact of the fourth quarter 2010 and 2009 LIFO adjustments, segment margin would have increased 120 basis points.

Thermal Equipment and Services

Revenues for the fourth quarter of 2010 were $418.8 million compared to $487.4 million in the fourth quarter of 2009, a decrease of $68.6 million, or 14.1%. Organic revenues declined 16.1% in the quarter, driven primarily by lower demand for cooling systems, particularly in China. The December 2009 SPX Heat Transfer Inc. acquisition increased reported revenues by 3.5%, while the impact of currency fluctuations decreased reported revenues by 1.5%, from the year-ago quarter.

Segment income was $52.8 million, or 12.6% of revenues, in the fourth quarter of 2010 compared to $63.3 million, or 13.0% of revenues, in the fourth quarter of 2009. The decline in segment income and margin was due primarily to the organic decline noted above, partially offset by the incremental income from the SPX Heat Transfer Inc. acquisition.

Industrial Products and Services

Revenues for the fourth quarter of 2010 were $167.9 million compared to $178.8 million in the fourth quarter of 2009, a decrease of $10.9 million, or 6.1%. Organic revenues declined 6.3% in the quarter, driven primarily by pricing declines for power transformers. Completed acquisitions increased reported revenues by 0.4%, while the impact

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— Barry L. Pennypacker, Gardner Denver's President and Chief Executive Officer.

of currency fluctuations decreased reported revenues by 0.2%, from the year-ago quarter. Segment income was $15.0 million, or 8.9% of revenues, in the fourth quarter of 2010 compared to $23.5 million, or 13.1% of revenues, in the fourth quarter of 2009. The decrease in segment income and margin was due primarily to the impact of the pricing decline for power transformers.

Gardner Denver Reports 4th Quarter 2010 Earnings

Gardner Denver, Inc. (NYSE: GDI) announced that revenues and operating income for the three months ended December 31, 2010 were $530.0 million and $80.4 million, respectively, and net income and DEPS attributable to Gardner Denver were $57.1 million and $1.08, respectively. The three-month period of 2010 included expenses for corporate relocation, due diligence and other items totaling $4.7 million, or $0.07 DEPS.

Compared to the three-month period of 2009, revenues increased 18% and orders increased 31%. The improvement in demand for Industrial Products was broad, occurring in every region of the world. Demand for Engineered Products was strong, with the most significant increases resulting from incremental demand for petroleum pump products and aftermarket services. Consolidated operating income improved 48% compared to the three-month period of the prior year, increasing to $80.4 million from $54.4 million in 2009. Operating income as a percentage of revenues was 15.2% in the three-month period of 2010, compared to 12.1% in the prior year period. The increase in operating income was largely driven by incremental profitability on the revenue growth, favorable product mix and the benefits of operational improvements previously implemented.

For the twelve-month period of 2010, revenues and operating income were $1,895.1 million and $252.4 million, respectively, and net income and DEPS attributable to Gardner Denver were $173.0 million and $3.28, respectively. The twelve-month period of 2010 included expenses for corporate relocation, due diligence and other items totaling $7.6 million, or $0.11 DEPS. For the twelve-month period of 2009, the net loss and per share basis net loss attributable to Gardner Denver were $165.2 million and $3.18, respectively. The twelve-month period of 2009 included expenses totaling $309.7 million, or $5.58 DEPS, for profit improvement initiatives, impairment charges and other items.

CEO's Comments

"The strong fourth quarter 2010 financial results reflect a continued improvement in our business environment combined with solid operational execution of our strategic priorities," said Barry L. Pennypacker, Gardner Denver's President and Chief Executive Officer. "We have positioned the Company to continue benefitting from strong organic growth in faster-growing end markets and geographies, such as energy, infrastructure and Asia Pacific. I am generally pleased with the progress we have made in executing our strategies and improving the operations, as evidenced by our operating margins expanding approximately 300 basis points and our achievement of record-breaking inventory turns of 5.8 in the fourth quarter of 2010. Both of the Company's reportable segments were able to deliver sequential profit improvement in the last three quarters of 2010. These results were driven by the efficiencies and focus that underpin the Gardner Denver Way, positioning us well for the future.

"In 2010, cash provided by operating activities was more than $202 million, or 117% of net income attributable to Gardner Denver. Our strong balance sheet and cash generation give us the flexibility to invest in the business and make further share repurchases and selective acquisitions, if the appropriate opportunities become available. In addition, we invested $33.0 million in capital expenditures in the twelve-month period of 2010, with a focus on reducing costs and increasing production output. We will continue to be very disciplined in terms of capital allocation."

Outlook

Mr. Pennypacker stated, "For 2011, we expect gradual improvements in capacity utilization to continue to drive demand for our Industrial Products and services including some replacement opportunities for industrial compressors and blowers. As a result of our expectation for gradual economic improvement in developed markets, we anticipate revenues for our Industrial Products to grow slightly in 2011, but continue to remain cautious in our outlook.

"Revenues for Engineered Products depend more on existing backlog levels than revenues for Industrial Products, and orders for Engineered Products are frequently scheduled for shipment over an extended period of time. Many of these products are used in process applications, such as oil and gas refining and chemical processing, which are industries that typically experience increased demand later in an economic cycle.

WALL STREET WATCH

Our current outlook assumes that demand for drilling pumps, well servicing equipment and OEM compressors will remain strong in 2011."

Mr. Pennypacker stated, "Based on this economic outlook, our existing backlog and productivity improvement plans, we are projecting the first quarter 2011 DEPS attributable to Gardner Denver to be in a range of $0.88 to $0.93 and our full-year 2011 DEPS to be in a range of $3.90 to $4.10. This projection includes first quarter and full year 2011 profit improvement costs and other items totaling $0.02 and $0.10 per diluted share, respectively. Full-year 2011 DEPS attributable to Gardner Denver, adjusted to exclude profit improvement costs and other items, are expected to be in a range of $4.00 to $4.20. The effective tax rate assumed in the DEPS guidance for 2011 is 28%. The Company expects capital expenditures to total approximately $45 million in 2011, as we continue to invest in growth initiatives and margin expansion projects on the shop floor."

Fourth Quarter Results

Revenues increased $79.2 million (18%) to $530.0 million for the three months ended December 31, 2010, compared to the same period of 2009. Organically, order and revenue growth were 32% and 19%, respectively, in the fourth quarter of 2010, compared to the prior year period.

Orders and revenues for the Industrial Products segment increased 23% and 17%, respectively, in the fourth quarter, compared to the same period of 2009, reflecting on-going improvement in demand for OEM products and aftermarket parts and services on a global basis. In the fourth quarter of 2010, unfavorable changes in foreign currency exchange rates reduced orders and revenues for the Industrial Products segment by 2%. Organically, this segment generated order and revenue growth of 25% and 19%, respectively, in the fourth quarter of 2010, compared to the prior year period.

Engineered Products segment orders and revenues increased 45% and 18%, respectively, for the three months ended December 31, 2010, compared to the same period of 2009, reflecting strong demand for drilling and well servicing pumps. In the fourth quarter of 2010, unfavorable changes in foreign currency exchange rates reduced orders and revenues for the Engineered Products segment by 1%. The ILMVAC acquisition, completed in the third quarter of 2010, increased orders and revenues by 3% and 2%, respectively. Organically, this segment generated order and revenue growth of 43% and 17%, respectively, in the fourth quarter of 2010, compared to the prior year period.

Gross profit increased $36.4 million (25%) to $180.7 million for the three months ended December 31, 2010, compared to the same period of 2009, primarily as a result of volume improvements, favorable product mix and cost reductions, despite the impact of unfavorable changes in foreign currency exchange rates. Gross margin increased to 34.1% in the three months ended December 31, 2010, from 32.0% in the same period of 2009. The increase in gross margin was due to the benefits of operational improvements, cost reductions, volume leverage and favorable product mix.

Selling and administrative expenses increased $14.5 million to $99.0 million in the three-month period ended December 31, 2010, compared to the same period of 2009, primarily due to corporate relocation costs and increases in compensation and benefit expenses, partially offset by cost reductions and changes in foreign currency exchange rates ($2.2 million). The ILMVAC acquisition, completed in the third quarter of 2010, added $1.1 million to selling and administrative expenses in the fourth quarter of 2010. As a percentage of revenues, selling and administrative expenses remained flat at 18.7% for the three-month period ended December 31, 2010, compared to the same period of 2009.

Depreciation and amortization expense was $15.4 million for the three-month period of 2010 and $17.4 million in the three-month period of 2009.

Operating income, as adjusted to exclude the net impact of expenses incurred for corporate relocation costs ($2.6 million), due diligence on an abandoned transaction ($2.2 million) and other items ("Adjusted Operating Income") for the three-month period ended December 31, 2010 was $85.0 million, compared to $59.2 million in the prior year period. Adjusted Operating Income as a percentage of revenues improved to 16.0% from 13.1% in the three-month period of 2009.

Net income attributable to Gardner Denver for the three months ended December 31, 2010 increased $19.9 million to $57.1 million, compared to $37.2 million in the same period of 2009. Diluted earnings per share attributable to Gardner Denver for the three months ended December 31, 2010 were $1.08, compared to $0.71 for the same period of the previous year.

Twelve Month Results

Revenues in the twelve-month period of 2010 increased $117.0 million (7%) to $1,895.1 million, compared to $1,778.1 million in the same period of 2009. This increase was primarily attributable to on-going improvements in demand for petroleum products, OEM products, and aftermarket parts and services, partially offset by unfavorable changes in foreign currency exchange rates.

Gross profit increased $75.8 million (14%) to $626.4 million in the twelve months ended December 31, 2010, compared to the same period of 2009, primarily as a result of volume improvements and cost reductions, despite the impact of unfavorable changes in foreign currency exchange rates. Gross margin increased to 33.1% in the twelve-month period of 2010, compared with 31.0% in the twelve-month period of 2009, primarily due to cost reductions and favorable product mix.

Compared to 2009, selling and administrative expenses increased $13.3 million in the twelve-month period of 2010 to $369.5 million due primarily to corporate relocation costs and increases in compensation and benefit expenses, partially offset by cost reductions. As a percentage of revenues, selling and administrative expenses decreased to 19.5% in the twelve months ended December 31, 2010, compared to 20.0% in 2009, primarily due to cost reductions and revenue leverage.

Depreciation and amortization expense was $60.2 million in the twelve-month period of 2010 and $68.7 million in the twelve-month period of 2009.

For the twelve-month period, operating income increased $366.1 million to $252.4 million in 2010, compared to an operating loss of $113.7 million in same period of 2009. Operating income as a percentage of revenues was 13.3% in the twelve-month period of 2010. The operating loss in 2009 was impacted by impairment charges ($262.4 million), as well as profit improvement initiatives and other items (totaling $47.3 million). The year-over-year increase in operating income was also attributable to cost reductions, revenue volume improvements and favorable product mix.

Adjusted Operating Income (a non-GAAP financial measure) for the twelve-month period ended December 31, 2010 was $260.0 million, compared to $196.0 million in the prior year period. Adjusted Operating Income as a percentage of revenues increased to 13.7% from 11.0% in the twelve-month period of 2009.

The Company generated net income attributable to Gardner Denver of $173.0 million in the twelve-month period of 2010, compared to a net loss of $165.2 million in the same period of 2009. The Company generated DEPS attributable to Gardner Denver of $3.28 in the twelve-month period of 2010, compared to a net loss on a per share basis of $3.18 for the same period of the previous year. Adjusted DEPS (a non-GAAP financial measure) for the twelve-month period ended December 31, 2010 were $3.39, compared to Adjusted DEPS for the prior year period of $2.40, reflecting a 41% improvement on a 7% improvement in revenues. BP

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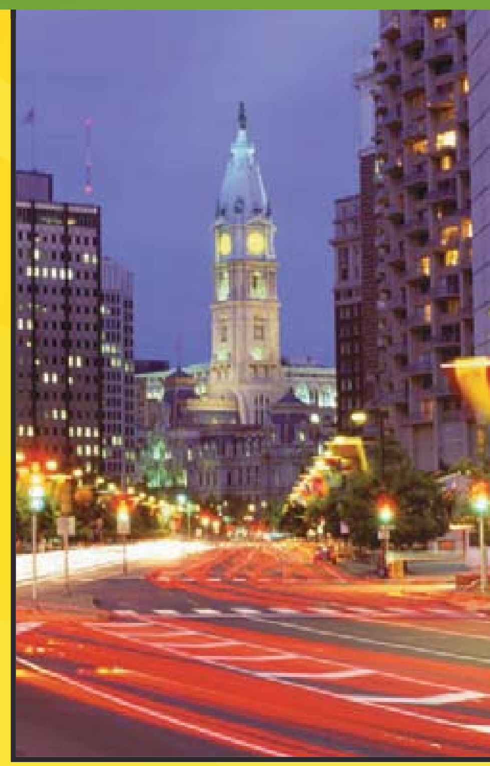

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