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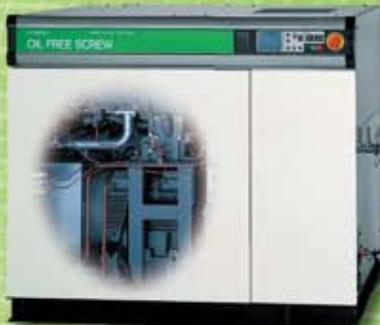
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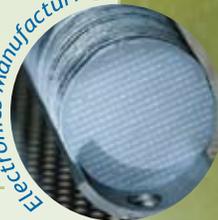
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## APPLICATIONS



## FROM THE EDITOR

### Food Grade Air



Some constructive work has been done over the past ten years by the compressed air industry to define compressed air system and quality requirements for the food industry. The "Oil in the Sausage" article in this edition reviews the requirements that have been developed for food air. The first is a recommendation on compressed air systems by the VDMA (German Engineering Federation). The second is a code of practice issued jointly by the British Compressed Air Society and by the British Retail Consortium.

One of the most difficult and oft-overlooked air system topics is understanding the quality of the ambient air an air compressor ingests. Hospital engineering firms do wind-current studies to better understand what air quality their rooftop compressor intake ducts will receive. It is no less critical for the food industry to understand intake air quality. Mr. **Scot Foss** provides us with an article on compressor intake contaminants. The article also provides ideas on how to measure and identify contaminants.

This roving reporter had two very interesting trips this past month. **Hitachi Air Technologies** held the inauguration of their new U.S. subsidiary in Charlotte, North Carolina. This \$80+ billion company began manufacturing air compressors in 1911. Mr. **Nitin Shanbhag** shared with me Hitachi's strategy to expand the availability of their oil-free rotary screw and oil-less scroll compressors in North America. I was also given the opportunity to visit the **2007 A.I.C.D. Meeting and Exhibition** in San Antonio, where a strong educational seminar was held along with a vendor exhibition. **Ron Nordby**, A.I.C.D. President, chaired the meeting, which was very focused on helping air compressor distributorships improve results.

It was interesting to hear that the Chinese government has recently closed over 150 factories (including food) due to quality-related problems. Measuring and verifying compressed air quality is an area of opportunity for the food industry. I commend the British Compressed Air Society for recommending in their code air quality measurement and verification two times a year. Remember how hospitals had dewpoint alarms going off every morning after the NFPA 99 Specification made dewpoint alarm systems mandatory?

ROD SMITH



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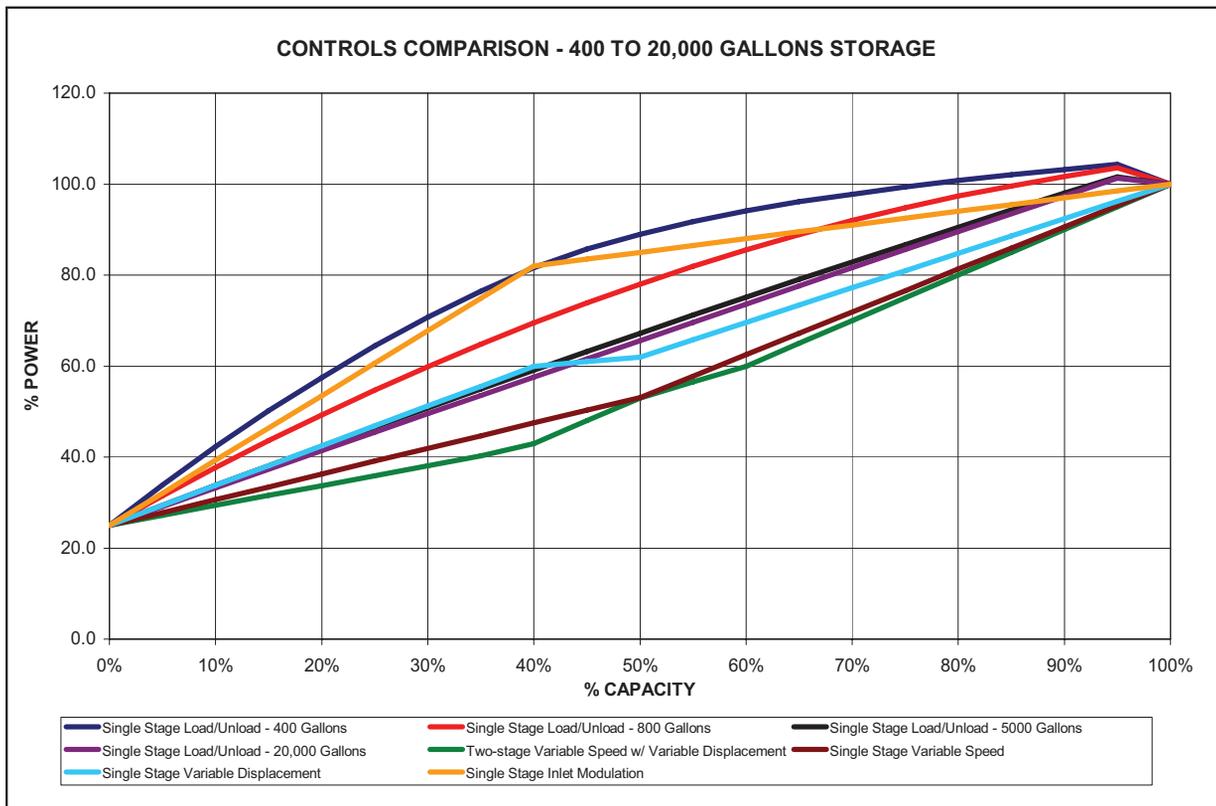
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# (( (FEEDBACK) ))

## Letters to the Editor

### VSD COMPRESSORS

I read the article by Frank Moskowitz, "Saving Energy with a VSD Compressor," (May, 2007) with great interest. It was very enlightening. The article, however, made a poor assumption with the load/no-load compressor power consumption. The graph shows a load/no-load compressor operating at a nearly perfect theoretic model. What is omitted is the fact there is blow-down time required to vent the air/oil reservoir to atmosphere (industry average is 30 seconds). Even then the power curve will not be a straight line as the system storage is a contributing factor to the power curve. The greater the storage, the closer to theoretical the curve becomes. However, the typical installation does not include sufficient storage needed for the compressor to reach the straight line. The typical 100 horsepower installation includes a 400 to 660 gallon receiver. This allows the compressor to unload and blow-down, but it will never reach the theoretic perfect energy curve



## FEEDBACK

I have included a controls comparison graph, with system storage from 400 to 20,000 gallons. Note that for a 500 cfm compressor, the average 100 horsepower screw compressor would require 5,000 gallons of storage to get the optimal performance. The performance does not improve much above that even at 10,000 or 20,000 gallons of reserve.

My second point is that the most efficient compressor has been omitted from the comparison. That is a two-stage tandem screw compressor with variable displacement air end and variable speed control.

Please keep up the good work. I will excitedly await the next issue of "Best Practices".

PHILIP COHEN  
SENIOR ENGINEER  
COMAIRCO EQUIPMENT

## HANNOVER FAIR

A note to let you know that I really enjoy your publication. I read it cover to cover.

Your fine recap of the big Hannover Fair (May 2007) made me want to get out my passport. I've naturally heard of the show but cannot imagine 6,000+ exhibitors at one location. Since my orientation is "government" and "marine," I go to SMM/Hamburg, which wears me out after two days, and it has "only" 2,000 exhibitors. Again, keep up the fine work.

DAVE BANNER  
HOWELL LABORATORIES

## HANNOVER FAIR

I just finished reading your article (May 2007) on the 2007 Hannover Fair in Germany. I was very impressed with the updates you wrote about. I attended the fair in 2001, VSD's were big that year!

Add me to your future "American Expedition" list.

GREG OWEN  
SALES MANAGER  
AIR COMPRESSOR DIVISION  
BREHOB CORPORATION

## SCOT FOSS INTERVIEW

Brilliant work on the Scot Foss Interview (May 2007) — I really enjoyed hearing about his history and insights into compressed air efficiency.

STEVEN SCOTT  
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# Oil in the Sausage

BY ROD SMITH

It was the fall of 1997 in Germany. I was just another guy working in the German compressed air industry. East Germans were still being looked down on — seven years after unification, the Euro was launching in little over a year — forcing marketing managers like me to scramble and create unified European pricing strategies. European Cohesion Funds were flowing out of Germany and into the Mediterranean (not literally), and the diminutive Mercedes “Smart Car” was the cool car for space-challenged urban dwellers. With this going on, you can imagine the surprise of the compressed air industry when compressed air was featured in *Der Spiegel*, a *Newsweek*-like weekly magazine in Germany.

“Oil in the Sausage” read the article headline! It proclaimed how a consumer-packaging expert had found mineral oil in a sampling of vacuum-wrapped sausage packages he had tested. The resulting investigation discovered that the food packaging facility in question did not have proper compressed air filtration systems installed. Oil vapors (hydrocarbons), present in the compressed air system, had entered the packaging machinery — which then injected them into the sausage package. The hydrocarbons condensed at a later date and were discovered by this consumer advocate product-tester.

You can imagine how the fingers started to point. The packaging machine manufacturer said it wasn’t their responsibility to provide quality compressed air — that it was the responsibility of the factory. The consumer advocate said, “Quatsch!” to that. He felt that all packaging machinery manufacturers should install activated carbon filters, which remove oil vapors, on the compressed air inlet side of their machines. He found that few do. He went on to sarcastically assert that the additional \$350 filter on the \$150,000 packaging machine should be economically feasible, given the potential liabilities. All eyes turned to the compressed air industry for a recommendation.

The objective of this article is to inform food industry compressed air users and specifiers of the recommendations provided in the U.K. and in Germany. The “Oil in the Sausage” story spurred a swift reaction from the German VDMA (German Engineering Federation),



which issued the recommendation we will document in this article. The U.K. standard (put together by the British Compressed Air Society and the British Retail Consortium) is more recent and incorporates the latest ISO 8573.1 air quality classes.

## ISO 8573.1 Compressed Air Quality Classes

Before discussing the food grade air recommendations, it is useful to understand ISO 8573.1 Air Quality Classes. In 1995, the International Standards Organization (ISO) announced a very practical way for compressed air quality to be defined. The ISO 8573.1 Standard established “Quality Class Numbers” to be applied to different levels of contamination in compressed air systems. Moisture, solid particulates and oil were identified as the primary contaminants in a compressed air system, and “Quality Class” numbers were applied to them. Quality Class numbers eliminate potential confusion over Fahrenheit/Celsius conversions, mg/ppm conversions, and language translations (can you say dewpoint in German?) in a specifying situation.

An end user can simply specify ISO 8573.1 **Quality Class 1.4.1** compressed air for his facility. The first digit represents Class 1 Solid Particulate Removal. The second digit represents a Class 4 Dewpoint of 3 °C (38 °F), and the third digit represents Class 1 Total Oil Removal of 0.01 mg/m<sup>3</sup> (0.01 ppm). The food industry compressed air standards we will review both used ISO 8573.1 as their way to specify compressed air quality.

## ISO 8573-1:2001 Air Quality Classes

Quality Class	SOLIDS			WATER		OIL & OIL VAPOR	Quality Class
	Max. Number of Particles per m <sup>3</sup>			Pressure Dewpoint		mg/m <sup>3</sup>	
	0.1 – 0.5 micron	0.5 – 1 micron	1 – 5 micron	°F	°C		
0	As specified by the end-user or manufacturer, and more stringent than Class 1						0
1	100	1	0	-100	-70	0.01	1
2	100,000	1,000	10	-40	-40	0.1	2
3	—	10,000	500	-4	-20	1	3
4	—	—	1,000	37.4	3	5	4
5	—	—	20,000	44.6	7	—	5
6	—	—	—	50	10	—	6

## Oil in the Sausage



Bottling barbeque sauce at a food processing plant.

### *A U.K. Code of Practice for Food Grade Air*

Such is the name of the code of practice jointly prepared in 2006 by the British Retail Consortium and the British Compressed Air Society (BCAS). Mr. **Greg Bordiak** is the technical officer of the BCAS who produced the code. For more information on acquiring a copy of the code, visit [www.bcas.org.uk](http://www.bcas.org.uk). The code is very complete and includes compressed air system installation requirements, compressed air quality specifications for “contact” and “non-contact” applications and verification methods.

Within the compressed air system installation requirement section are recommendations for air compressors. The importance of the quality of intake air is emphasized to prevent the introduction of dust, hydrocarbons and chemical vapors into the air compressor. The importance of intake filtration (with regular maintenance) is also emphasized. The code of practice also suggests that in installations with potential contamination areas with risk, known as critical control points (CCPs), that food-grade lubricants be required if lubricated (oil-injected) air compressors are used.

The use of carbon steel pipe is discouraged because it can corrode in the presence of moisture in the compressed air. Other piping materials such as aluminum, copper, stainless steel and plastic are encouraged. It is noted that with plastic pipe, considerations for temperature acceptance of the plastic pipe material should be made.

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Contact is defined in the code as, “the process where compressed air is used as a part of the production and processing including packaging and transportation of safe food production.” The code of practice calls for the equivalent of ISO 8573.1 Quality Class Air 2.2.1. The second “2” digit calls for a -40 °C (-40 °F) pressure dewpoint. This dewpoint specification therefore recommends the installation of desiccant air dryers and membrane air dryers (for lower flow volumes).

Non-contact is defined in the code as, “the process where compressed air is exhausted into the local atmosphere of the food preparation, production, processing, packaging or storage.” This application calls for the equivalent of ISO 8573.1 Quality Class Air 2.4.1. The “4” digit specifies a +3 °C (38 °F) pressure dewpoint — which signals the possible use of a refrigerated air dryer. Whether or not separate drying systems (desiccant and refrigerated) are practical will depend upon the characteristics of each installation. Some may find it more practical to use one desiccant air dryer for the whole installation. They should, however, be aware of the energy costs involved with desiccant air dryers versus refrigerated air dryers.

**BCAS & BRC FOOD GRADE PURITY RECOMMENDATIONS:**

CONTACT RECOMMENDATION	DIRT (SOLID PARTICULATE) MAX NUMBER OF PARTICLES PER M <sup>3</sup>			HUMIDITY (WATER VAPOUR)	TOTAL OIL (AEROSOL + VAPOUR)	ISO8573.1 EQUIVALENT
	0.1-0.5 MICRON	0.5-1 MICRON	1-5 MICRON			
Contact	100,000	1,000	10	-40°C PDP	0.01 mg/m <sup>3</sup>	Class 2.2.1
Non-Contact — Low Risk	100,000	1,000	10	+3 °C PDP	0.01 mg/m <sup>3</sup>	Class 2.4.1
Non-Contact — High Risk	100,000	1,000	10	-40°C PDP	0.01 mg/m <sup>3</sup>	Class 2.2.1

Reference Conditions from ISO8573.1: Absolute atmospheric pressure 1 bar, Temperature = 20°C. Humidity is measured at air line pressure. Chart provided courtesy of Parker domnick Hunter.

Particulate and oil removal filtration are specified as ISO Classes “2” and “1” respectively, for both contact and non-contact applications. This means that one micron filtration for particulates and 0.01 mg/m<sup>3</sup> (0.01 ppm) oil coalescers and activated carbon filters will be required. Please note that the code specifies “total oil,” which therefore mandates the use of activated carbon filters (also known as charcoal filters) which can capture oil vapors (particularly hydrocarbons).

The BCAS/BCR Code of Practice has a section dedicated to measurement and testing. This is an area of great opportunity in compressed air systems. Too many installations are installed and as long as they keep functioning — it is assumed that all is well. The hospital industry worked in this way for many years until they decided to install CO monitors and dew point alarms independent of the dryers. This code recommends testing the installation twice per year for solid particles (dirt), humidity, total oil and microbiological contaminants. The code suggests the appropriate ISO codes which define how to conduct the specific tests for air purity.

**Lubrication Standards**

Lubrication standards cover what lubricants an air compressor may use in a food industry application. The United States Department of Agriculture (USDA) has requirements for the use of the designated H1, H2 and H3 lubricants. NSF (National Sanitary Foundation) also has a standard (NSF 116-2000) which follows Germany’s food grade lubricant standard DIN V 0010517, 2000-08. It is up to the factory to determine what lubricants are required in the factory. The guidelines provided by the USDA on lubricants are:

- H1 lubricants are food-grade lubricants used in food-processing environments where there is the possibility of incidental food contact
- H2 lubricants are nonfood-grade lubricants used on equipment and machinery where there is no possibility of contact
- H3 lubricants are food-grade lubricants, typically edible oils, used to prevent rust on hooks, trolleys and similar equipment



## Oil in the Sausage

### *Germany's Recommendation for the Food Industry*

The VDMA (German Engineering Federation) section for the compressed air industry responded swiftly to the “Oil in the Sausage” situation in 1997 with a document titled “Recommendation for Compressed Air Quality in the Food Industry.” It used ISO 8573.1 as its method to specify air quality, and it recommended the required air treatment equipment to achieve the desired air quality. It is interesting to note that the front page of the recommendation stated, “this recommendation applies to all air compressors independent of type.” This is an obvious reference to oil-free vs. lubricated air compressors and suggests that air treatment requirements are the same for either compressor technology. For a copy of the recommendation, visit [www.vdma.org](http://www.vdma.org).

The VDMA recommendation was written in two sections:

1. For packaging machines where compressed air is in contact with packaging material which is directly in contact with the food or drug product
2. If the compressed air is in direct contact with the product or mixed with it.

“A consumer-packaging expert had found mineral oil in a sampling of vacuum-wrapped sausage packages he had tested.”

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In both sections, the recommendations varied based upon the pipework. If the pipework in the facility is new or cleaned, centralized air drying and filtration systems are recommended. If the pipework is “polluted or hard-to-clean,” centralized air drying and decentralized filtration are recommended. By “centralized,” the VDMA means the location of the air treatment equipment can be next to the air compressors in the compressor room. “Decentralized” means that the air treatment should be located on the factory floor directly upstream of the machine or process where compressed air can come

into contact with food. The recommendation states that new or cleaned air pipework should be made of:

1. Zinc-plated steel suitable for food
2. V2A/V4A
3. Compressed air-approved plastic
4. Aluminum

Another installation note was that no system bypasses be used.

The recommendation calls for ISO Class 4 moisture removal, which is a 38 °F (3 °C) pressure dewpoint in all situations. It does state that the refrigerated air dryers should have a dewpoint alarm built into the unit. There is also a note that for direct contact applications with extremely moisture-sensitive products, Class 4 is not sufficient and a desiccant or membrane air dryer should be used.

Oil removal and particulate removal are both specified as per ISO 8573.1 Air Quality Class 1. The section on indirect contact suggests using a 0.01 ppm coalescer followed by an activated carbon filter. The section on direct contact suggests using a 1 micron filter, a 0.01 ppm coalescer, and an activated carbon tower/adsorber. Sterile filtration is also recommended in all situations where seen as appropriate.

### Conclusion

The codes and recommendations put forth by the BCAS/BRC and by the VDMA provide the compressed air user and specifier in the food industry with some guidelines to consider. The opinion of the author of this article is that the ongoing maintenance of the systems and measurement/verification of air quality, as put forth in the BCAS code, is an area to be pursued with more vigor by the industry. Compressed air systems in the food industry today remind me of hospital air installations before the NFPA 99 Regulation made independent dewpoint alarm systems mandatory. Compressed air system awareness and education has come a long way since the “Oil in the Sausage” article in 1997. Let’s take it a step further.

For more information, contact Rod Smith at Compressed Air Best Practices Magazine, tel: 251-680-9154, email: rod@airbestpractices.com.

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# AIR COMPRESSOR INLET CONTAMINANTS



The following article is an excerpt from *Compressed Air Systems—Solution Series* (copyright 1994), written by R. Scot Foss. For more information on acquiring the book, call 904-940-6940 or email [airsagas@aol.com](mailto:airsagas@aol.com). A portion of the proceeds from this book are donated to selected children's charities.

Probably the only questions or discussions regarding the inlet conditions are relative to location. A common question in seminars is, "Should you have the inlet inside or outside?" There aren't any canned answers to questions like this. There are many issues that need to be considered. One certainly is the potential presence of airborne contaminants, which may be introduced into the compressor intake.

## *Negative Pressure*

The air compressor room is normally the hottest, driest, and most negative space in most industrial plants. If you leave the compressor inlet inside a space that is ventilated, but not air conditioned, you should remember that you must contend with the heat without generating a negative pressure environment. This not only makes the compressor room the plant's vacuum cleaner, but also attracts airborne industrial vapor into the compressor room.

Over the years I have seen a number of fires and auto-ignitions that occurred as a result of ingesting volatile gases which were induced into the compressor room. An example of this

is when a negatively ventilated compressor room is adjacent to a paint system that is positively ventilated with solvents present. Normally, shortened life of compressor lubricant and cooler pitting are good predictive maintenance indicators of this situation.

## *Aggressive Caustic and Acidic Gases*

Another common problem relative to inlet conditions includes the presence of aggressive caustic and acidic gases. Most of these gases are the results of industrial processes and products of combustion. This may not be from the plant in question, but may be present in the atmosphere from adjacent plants or decomposing refuse areas. Even in small quantities such as 3-10 ppm, these gases will take their toll, in time attacking the compression components as well as the coolers.

During sunrise and sunset in many areas there can be temperature differentials of more than 10 °F between the ground and air temperature. This is called an unfavorable delta "T." This produces not only fog and smog, but will significantly increase the content of industrial waste gases present at the inlet of the compressors. Most users find out about this after this condition has done considerable damage to the compressors. In lubricated compressors, the lubricant will react in a variety of different ways.

The gas combined with the lubricant must be investigated to determine the reaction. The lubricant becomes the sacrificial material as opposed to the compressor. In non-lubricated compressors, the gas combined with water in the intercooler can form acids, which attack the coolers.

### *Cooling Tower Blow-Off*

Other inlet contaminants can include heavy water with treatment chemical by-products, which frequently are ingested from cooling tower blow-off, which is carried to the inlet with prevailing winds. If you have step controls on the cooling tower fans and pan heaters, the moisture will occasionally billow out of the tower. This causes corrosion on the air side of the compressor, again resulting in contamination and pitting.

In one application we had found corrosion that was so severe on the air side of the coolers, that we hooked up a video camera to monitor the inlet of the compressors on the roof of the compressor room. We found that the tower blow-off would flow directly into the compressors.

The corrosion was commensurate with a 20-year installation in less than 5000 hours of service. You should also check to see what by-products can be present in the cooling tower blow-off from the chemical treatment. Sometimes chlorine or other aggressive materials can combine with water to attack the compressors. Discharge baffles will help in this case, but the best solution is a thoughtful installation.

### *Airborne Hydrocarbons*

Common to most inlets would be hydrocarbons, which are airborne. It would be normal to find 6–10 ppm of hydrocarbons even in a residential neighborhood. In a heavy industrial area with a lot of vehicle traffic, we have measured 16–24 ppm of hydrocarbons. In many cases, 20–30% of these hydrocarbons may be condensable.

Another common nuisance cause of hydrocarbons or oils to the inlet,

especially in oil-free compressors, is the lubricant sump demister. In an audit of a semiconductor facility where the client had installed heat recovery on his air-cooled, non-lubricated, rotary screw compressors, the oil sump demister was discharging into the cooking air. The return air duct on the heat recovery system was returning the sump blow-off back to the inlet of the compressor. In another plant making pharmaceuticals with similar types of compressors which were in enclosures, the demister was discharging in the enclosure. Between the effect of the prevailing winds back-drafting the air coolers, and the parking lot emissions adjacent to the compressor intakes, we found substantial condensed oil in the air system. If you have instrument taps, such as Pete's Plugs, in the control system of the compressors, this can be an excellent point to check for the presence of hydrocarbons from time-to-time.

### *Airborne Particulate*

Other inlet contaminants include airborne particulate, which can clog up coolers and lubricant filters and load on compression elements such as impellers and

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## AIR COMPRESSOR INLET CONTAMINANTS

diffusers. Sometimes this will cause over-heating between stages and occasional reductions in performance. This can cause unstable conditions, loss of efficiency and vibrations on the compressor.

When ingested in electric motors, corona arcing can result in breaking down the motors prematurely. When airborne particulate which have electrical charges are ingested into compressors which have poor electrical grounding, fires and auto-ignitions can occur from corona arcing within the lubricant sumps of compressors. This last occasion would be more typical in rotary screw compressors. If you have electrically charged, airborne particulate present, you may want to check carefully to find out how the compressor and the sump are grounded. Different manufacturers approach grounding in different ways.



We have found, in some cases, that original equipment manufacturers use a ground that is added to the separator. If you were to replace the separator with a non-original filter separator, you might eliminate the ground for the compressor, subjecting the machine to the risk of damage.

Common dirt and dust should be kept out of the compressor. As the velocity of the compression process increases, the ingestion of particulates becomes more critical. Even particulate as small as 5-10 microns in size can cause substantial wear to impellers and diffusers on a centrifugal compressor and some higher speed non-lubricated screw compressors. You should also check to see if there are any necessary coatings in the compression chambers, which are subject to wear or removal from abrasion. A filter element which is not properly seated in its housing can be the culprit in higher than normal wear with these types of compressors. Larger particulate in a rotary screw compressor can eventually wear down the sealing strips and cause performance problems.

### *Testing Ambient Air at the Inlet*

If you have an existing compressor system, you should take a sample from time to time of intercooler drainage. This should be tested for pH content and compared against the last test. As most compressor effluent is made up of distilled water, the pH will be a strong indication of the inlet. Many manufacturers of screw compressors currently use lubricants which have breakdown mechanisms, which go acid on breakdown. Lubricant tests, in this case, become the factors to determine the acid content and required lubricant change intervals.

You should also take a bag sample of the inlet to determine the particulate with which you are dealing (gases and ppm) and how they react when combined with your lubricant and water. The tests most common for this investigation would be a gas chromatograph and a gravimetric analysis. These samples should be taken near the inlets of the compressors approximately one hour after sunrise and half hour after sunset. The most pronounced concentration of airborne contaminant will occur in the spring and the fall at these times of unfavorable delta temperatures.

You may also want to take a particulate sample over several hours and subject the material to compatibility testing, as well as a screen test to determine the volume of various size particulates to determine the inlet filter selection. Depending on what the particulate is and how it can affect the compressor, 1 or 2% of the particulate by weight or volume may be all that you can tolerate downstream of the inlet. The sheer volume of particulate may create a unique condition requiring a special approach toward the inlet.

Please keep in mind that manufacturers of compression equipment make maintenance recommendations based on what they consider typical conditions. This is seldom defined. We have frequently seen inlet filters collapse or “rat hole” from heavy inlet particulate where the inlet filter is changed based on a time interval. In all cases, the best choice is to instrument the inlet with a magnahelic or photohelic, comparing the outside ambient pressure to the compressor throat suction to determine the inlet filter changes.

The majority of installations have never considered the inlet conditions with sufficient depth when selecting the air compressors and determining how to install them into a system. The results are substantial maintenance problems combined with poor performance. In some cases the problems can also involve frequent interruptions to production and liability risks to the owner operator.

For more information, please contact Scot Foss, Senior Auditor, Plant Air Technology, email: [airsagas@aol.com](mailto:airsagas@aol.com), tel: 704-844-6666, [www.plantair.com](http://www.plantair.com).

“If you have an existing compressor system, you should take a sample from time to time of intercooler drainage.”

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# HARRIS

*Compressed Air Best Practices interviewed Gary Pollack (president) and Tony Beaman (engineering manager) of the Harris Equipment Company.*

## How has Harris Equipment evolved over the years?

Harris Equipment was founded in 1936, originally as an electric motor repair business. It soon evolved into an assembler of compressor packages, whereby bare pumps and all related components were assembled and mounted on a single common base or receiver tank. This new business soon flourished, and Harris Equipment became a reliable source for complete plant air compressor systems servicing the burgeoning metropolitan Chicago area.

Over the years, we have been authorized distributors for Kellogg American, Ingersoll Rand, Worthington, Joy, Sullair, and in the 1940s and 1950s even sold some Quincy's. While servicing the larger reciprocating-type compressors, Harris quickly recognized the opportunity for the repair, manufacture and re-tubing of shell and tube after-coolers and intercoolers. ASME code certification came soon afterward (both "U" and "UM" stamps — still in existence today in a related company). Heat exchangers, both off-the-shelf and custom-manufactured units, continue to be a very viable profit center at Harris Equipment.

In 1996, Harris Equipment purchased National Compressor, an old-line Ingersoll Rand distributor whose relationship with Ingersoll had come to an end. We had a large interest in their customer base and were very successful in maintaining and managing these relationships. We used the opportunity to successfully grow our service and parts departments and, of course, to sell complete units whenever the opportunity arose.

Over the years, our service capabilities have grown significantly, and we are totally adept at repairing all makes and models of screws, pistons, vanes and vacuum pumps. We have on our staff certified refrigeration technicians for refrigerated air dryers. We boast one of the largest parts inventories in the Midwest and possess a service fleet of modern vehicles with experienced factory-trained service technicians.

## What does Harris Equipment look like today?

Harris Equipment is housed in a 25,000-square-foot facility in a western Chicago-land suburb. The facility has two overhead cranes (10 and 15 tons and 18 feet under the hook) and all the resources required to respond to any and all of our customers' needs, whether for planned maintenance or emergency breakdowns.

We have 27 employees, most of whom are very veteran workers. We have a family atmosphere and provide a comfortable place to work. The person sweeping the floor has immediate access to the president, and we are all focused on pleasing customers. We offer 401k, medical and dental plans which are in line with the market. We actually hear from our employees that our health plan is better than most. Some people try to recruit our employees and find that their programs don't compare favorably.

## Please describe your focus on customer service.

Harris Equipment is a "WE CARE" company. Although many companies give lip service to their level of customer concern, Harris Equipment practices total customer satisfaction at all times, and every Harris Equipment employee knows and understands that our customers are the only reason we are in business.

Examples? We try to answer the phone the first time. We don't let people go on hold on the phone. A person called and asked if we could service another brand of equipment because his compressor was down. He needed a 100-horsepower rental and had called his local guy. We solved the situation before his local guy returned his phone call.

Another end user called his distributor and couldn't get through to service. He then called us and we sent a guy and fixed his air compressors. Six hours later, while the end user was signing off on the job, his distributor called to see what was going on. That same end user then called us to purchase two 25-horsepower compressors, a refrigerated air dryer and the installation.

We are very strong on this fundamental focus. How many service companies will have the president of the company go out to see the end user? Another end user needed some small components, like a replacement filter element, and his dealer sloughed him off. Our sales guy visited him immediately and took care of his needs. The same end user later purchased two 150-horsepower air compressors from our company.

We simply have zero tolerance for poor customer service.

# EQUIPMENT COMPANY

Harris Equipment has built a unique capability to rebuild machinery. The company can rebuild all types of air compressors and all types of heat exchangers. The company has a dedicated heat exchanger rebuild shop.

Specialty jobs are done, like work on Joy 119 and 112 intercoolers and aftercoolers. Heat exchangers used to cool the hydraulic systems on injection molding machines are rebuilt as well. Double-tube heat exchangers for potable water in hospitals or for the Chicago Housing Authority are also rebuilt.

The primary focus is on rebuilding all brands of air compressors. The company does its own air-end rework and provides a 5-year air-end warranty on all rebuild jobs.



Step 1: Air compressor is received to begin a rebuild job.



Step 2: Air compressor is stripped for bench rebuilding of major components.



Step 3: Air compressor is assembled from rebuilt components.



Step 4: Air compressor is fully tested and ready for paint.



Step 5: Air compressor is finished and ready for crating and shipping.

## Sullivan Palatek

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## HARRIS EQUIPMENT COMPANY

### Is Harris Equipment in the auditing business?

We devote a substantial amount of time to educating our customers regarding the relationship between their compressed air and their electricity bill. We engage in seminars and air audits to adequately size systems and sell VFD technology ONLY in the appropriate circumstances. We are finding more and more situations in which some of our competitors recommend VFD units even in inappropriate situations. Our philosophy has always been to seek the best solution for our customers and not just to succumb to the “flavor of the day.” All our sales engineers know, recognize and understand that both fixed and variable speed units need to be placed where best suited.

### The late 1990s really tested Harris Equipment, right?

Absolutely. In 1974, Harris Equipment began selling the Sullair air compressor line on a casual basis, purchasing both compressors and parts from the then-Sullair subsidiary office. This relationship continued on a “handshake” basis until the purchase of Sullair by Sundstrand, who insisted that all Sullair distributors be placed under contract. Harris signed the contract and “legitimized” its relationship with Sullair at that time. When Sullair closed its subsidiary office, a second Sullair dealer was appointed in the greater Chicago-land area, and a dual distribution system existed until 1999. Sullair found themselves with dual distribution in two markets (Chicago-land being one of them). They decided to rationalize their distribution chain and thought that the best way to market for them was via a single distributor in each market area. We were very hopeful that we would be the surviving distributor, but Sullair opted for the second distributor in town — rather than Harris Equipment. At that point in time, we were extremely disappointed and most concerned about the viability and future prospects for our business.

Were we ever surprised! To our extreme delight, and after an extensive customer survey, we came to realize and recognize Harris’ value to our very loyal customer base. It became very clear to us and was indeed expressed to us on more than one occasion that the brand our customer recognized was the Harris Equipment brand. The Harris Equipment name was more important to them than the name of the air compressor we sold. Our customers told us that their confidence was in us, since we were the ones with whom they had the relationship and to whom they looked when they were in need. They told us to find a line of air compressors that was competitively priced, well made and reliable and that the name stamped on it was irrelevant as long as we would be around to provide parts and service and keep it running.

### What air compressor product line did you switch to?

After looking at various options, we decided to partner with Sullivan Palatek. Our reasoning was that the factory was close (about an hour from our shop), their people were extremely knowledgeable about the industry, and their products were simple and easy to work on. Their compressors were very reliable and had one of the best warranties in the industry — we believe they were the pioneers of the 5 year air-end, motor and coupling warranty.

## Compressed Air for Chicago’s

The Chicago region has a significant amount of food processing and packaging industries. Harris Equipment has extensive experience working with the multiple types of food industry facilities. Factories processing vegetables, sugar, pork, beef, poultry products, dairy products, sauces — are all present, and that’s just a few examples. There are small firms and big companies as well. We service many smaller brands of powdered sugars and others who make packaging for food (like ready-to-eat-foods).

### Compressed Air Applications

Many food processors produce their own packaging. Blow molding is quite common in dairies. Many prepared foods are presented in their own packages. These thermal-set containers can be vacuum molded pressure molded, or molded using a combination of both. Many beverage containers are blow molded at the processing plant.

Powder products are transported and packaged using compressed air. With sugars, compressed air is used to bulk transport the product in dense phase and put the powder in the bag. Another application is with food products that have compressed air emitted into it to mix and aerate it. Pastes like spaghetti sauce are an example.

A wide variety of food processing equipment consumes compressed air. This varies from meat saws to packaging equipment. Sealing knives use an air cylinder, which provides better control. Air-driven mechanical mixers are used quite often to mix and blend products.

Vegetable peeling machines utilize compressed air to prepare raw food stocks for packaging and consumption. The vegetable peelers use a jet nozzle of air to peel onions and other vegetables. A vegetable processing plant we work with uses onion peelers from two different manufacturers. The most prevalent peeling machine uses 90 psig compressed air, while the other uses 130–150 psig. Rather than pay the energy costs of operating the entire plant’s 325 horsepower at 150 psig, Harris recommended and provided two separate systems. One was a high pressure system (150 psig) and the other was a lower pressure system (100 psig). The result was an annual energy savings of \$5,400.

### Piping

Piping requirements depend upon the local inspector and his personal experience. We see clean stainless steel systems, and we also see plain old black iron pipe. Even in the meat industry, where you see USDA and FDA inspections, we see a lot of black iron. We recently visited a food manufacturer working with animal fats who had just finished putting in a brand new black iron piping system for compressed air. The problem here is that compressed air treatment systems are often inadequate and the black iron pipe will begin to rust and also potentially incubate microbiological growth.

## Food Industry

### Air Compressors

Food processing plants use both lubricated and non-lubricated air compressors. Non-lubricated air compressors make air treatment easier because the air is oil-free. Please note that oil and vapor can still be introduced into compressed air systems from the ambient air being compressed. Proper filtering and drying is still required. The difference between air compressor types is the maintenance of the filters. In general, non-lubricated compressors (below 300 horsepower) are more expensive to purchase, have shorter service lives and are not as energy-efficient as their lubricated counterparts. At higher horsepowers, centrifugal air compressors are more cost-efficient and should be examined for any application.

### Moisture and Oil Removal

Compressed air in the food industry must be free from contamination and not promote biological growth. Many applications have compressed air coming into direct contact with the food.

No matter how you compress the air, the air has to be treated. The air we use for the compressor intake is from an urban area. Our air quality isn't great in Chicago, and ambient hydrocarbons are often present. Many applications use lubricated air compressors that will contain lubricants. Even with non-lubricated air compressors, the source air that is compressed contains contaminants and biological matter that must be removed. This can only be accomplished by the proper treatment of the compressed air as it discharges from the air compressor.

The air must be dried to remove moisture from the air stream. As the air leaves the air compressor, it is liquid free but its dewpoint is the same as its temperature. Especially with air-cooled air compressors, the compressed air temperature is higher than the surrounding environment. This results in immediate cooling and results in water condensing in the line. No amount of filtering will stop this. The air continues to cool as it travels away from the compressor, constantly condensing water.

Two types of air dryers are commonly used in the food industry. Refrigerated dryers are units that cool the air to just above freezing, condensing, trapping and draining the condensed water. The dehumidified compressed air (+ 40 °F pressure dewpoint) is then distributed throughout the plant. If the compressed air remains above the dewpoint temperature it reached in the dryer, the air will remain liquid-free.



*Air compressor at a large meat packer.*

However, most food processing plants have areas that are refrigerated below the dewpoint provided by the refrigerated dryer. In these applications, desiccant air dryers are used to provide pressure dewpoints to -40 °F or -100 °F.

The filtration process should be staged to reduce operating costs. The first stage should be a coarse coalescer (1 micron rated and larger) to remove the larger volumes of contaminants, while giving resistance to plugging. Tighter (smaller micron rated) filters should follow to provide better contaminant removal. The tighter the filter, the more prone it is to plugging. Two- and three-stage filter systems are recommended. Where odor or vapor control is important, activated charcoal filters are needed. The exhaust from a diesel truck engine that is pulled through the air compressor will pass through a dryer and filters because it is vapor. Only a charcoal filter will remove these vapors. Besides the truck idling in the shipping bay, there are other sources of air contamination. A careful examination of all processes in the plant must be undertaken to be sure what compressed air vapor control is needed.

For more information, please contact Mr. Anthony Beaman, Harris Equipment Corporation, Tel: 708.343.0866, email: [tbeaman@harrisequipment.com](mailto:tbeaman@harrisequipment.com).

## HARRIS EQUIPMENT COMPANY

We jumped out of the Sullivan Palatek gate with extreme enthusiasm and with a point to prove. Their products continue to be very competitively priced, extremely reliable and easy to service. Their wonderful attitude and desire for their distributors to succeed is most refreshing. Their people are always accessible, their deliveries are very reasonable (in emergency situations, they always go the extra mile), and they display a genuine interest in their customers. Being a smaller compressor manufacturer, they are able to provide access to the corporate president, who is extremely knowledgeable, highly ethical and a man of his word. Since corporations are top down institutions, these attributes seem to permeate the whole company. No wonder Sullivan Palatek has experienced such remarkable growth over the past few years! Our relationship with Sullivan Palatek, since 1999, has grown and flourished, and our partnership with them continues to be mutually profitable.

### Your firm is quite diversified. What other product lines do you sell?

We have also had a long and fruitful relationship with Donaldson Ultrafilter Air-Cel and have for many years been proud to be associated with their superior line of dryers, filters, chillers and fluid coolers. Their products have proven over the long run to be of the highest quality with zero to negligible failure rates, and they are another company who really values their distributor relationships. Donaldson's recent purchases have brought excellent management, a commitment to succeed and a desire to be the best in the industry. While their warranties are very strong, our warranty claims are extremely low, and they have always been a pleasure to deal with.

In December 2000, we purchased Mercury Pneumatics, a fluid power distributor and the largest private Watts and Dynaquip distributor in the USA. We have maintained this business and continue to carry FRLs, quick couplings, disconnects, pneumatic and electric actuated ball valves. Our inventory is so substantial that many distributors across the country purchase from us when the factory has long lead times.

In late 2003, we successfully sourced replacement Kellogg American models 321, 332, 335, 352, 452 and 462 pumps (from 5–25hp). Since the merger between Kellogg American and LeRoi, these pumps have been discontinued, and we thought it would be a good idea to take advantage of the replacement pump business — because a very large population of these units exists around the country. Over the years, we had sold several hundred units ourselves, and we established a dealer network throughout the country to offer those in need of the pump alone an opportunity to purchase it. Each year since we began this business unit, our volumes have increased incrementally.

In August 2004, we were re-appointed the exclusive representative (in Illinois, Eastern Iowa and Northern Indiana) of Tuthill Corporation/ M-D Pneumatics, a well respected line of positive displacement rotary blowers. Harris Equipment believes that a distributor capable of offering a variety of related products and services to its customers is a more valuable supplier/partner to its customers and therefore more likely to maintain long-term relationships.

2007 marks our 71st year in business, and we feel very confident that we have the best people in place, excellent products to sell and the highest level of customer commitment that will take us into the next 71 years with optimism, pride and continued success.

For more information, please contact Mr. Gary Pollack or Mr. Anthony Beaman, Harris Equipment Corporation, Tel: 708.343.0866, email: [gp@harrisequipment.com](mailto:gp@harrisequipment.com), web sites: <http://www.harrisequipment.com>, <http://www.compressorparts.bz> and <http://www.mercurypneumatics.com>.



*Air compressors installed at a food packaging manufacturer.*

# Hitachi America

*Compressed Air Best Practices interviewed Mr. Nitin Shanbhag, senior manager of Hitachi Americas' Air Technology Group, during the Grand Opening of their facility in Charlotte, North Carolina.*

## Congratulations on the Grand Opening!

Thank you. Hitachi has made a strong commitment to the North American market, as evidenced by this facility in Charlotte. Today's grand opening inaugurates this 27,000-square-foot facility, which is fully stocked with a multi-million dollar inventory of our oil-free scroll and oil-free rotary screw air compressors.

In typical Hitachi fashion, we have worked all this time to make sure our infrastructure was perfect before announcing our presence to the market. The products are in stock along with all the required spare parts. I saw that the regulatory approvals were critical. We sent the UL guys to Japan and got our panel shop in Japan approved by the UL. This was a big upfront investment, but now every package has UL approved components and a UL approved panel. Hitachi made accommodations on the product labeling by including safety messages common in the U.S. but not normal in Asia. We also "North Americanized" all of the support information —

particularly the instruction manuals. We had to work to get the language right so that the interpretations were exact and that the English was "American." It was also necessary to create new sets of engineering data, quotation shelves, brochures and tech sheets.

We have been able to recruit an outstanding staff of veteran air compressor people in technical service, sales engineering and technical marketing. The company is also fully staffed with promotional marketing, administrative and finance personnel.

The facility includes a hands-on service training area, designed to train service technicians in service schools, which include segments on compressor assembly and disassembly. Classroom training is done for sales engineers and service technicians in our electronically enabled training room, which includes broadband internet access for every participant.



*Mr. Kiyoshi Kinugawa addresses the crowd during the inauguration ceremony in Charlotte.*



*Mr. Masakazu Aoki, Mr. Nitin Shanbhag, and Mr. Yoshihko Mizushima*

## HITACHI AMERICA

### Why has Hitachi now entered the North American market directly?

We manufactured our first air compressor in 1911 — recip technology. The global business was primarily in Japan until only 20–30 years ago, when we started selling into other markets in Asia. We then developed some strong OEM relationships in the U.S. with our oil-less recip, vortex blowers and oil-free scrolls. The success in the U.S. market of these product designs have further driven our new product development efforts around the needs of the U.S. market for oil-free technologies.

Hitachi has recognized the strong market potential for our unique oil-free products. Market analysis showed us that the oil-free technologies have a lot of need/demand in the USA. The vertical markets like food and beverage and electronics continue to re-evaluate their standards for air quality. This increased awareness of the compressed air systems has encouraged the adoption of oil-free technologies.

Demand for environmentally-friendly products is increasing in North America. This includes the topic of lubricants and sound. Many users simply want to consume less oil and be more environmentally friendly. They do think about the ecological ramifications of what they are buying. Low sound ratings are also more important than ever in this market. The work environment is being improved through the purchase of quieter machinery — including air compressors.

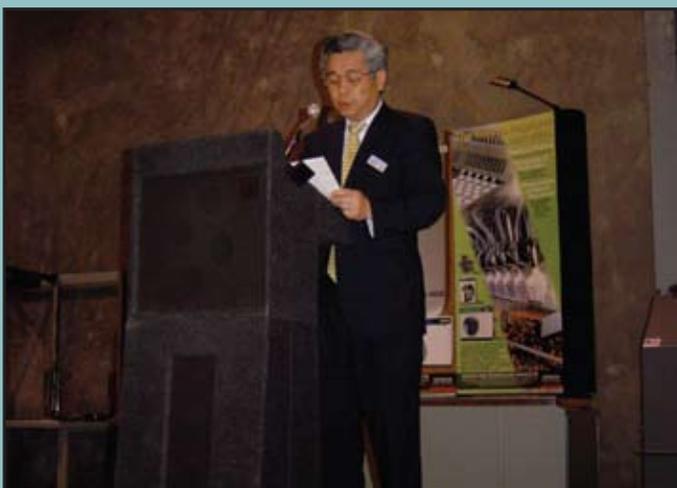
These market trends match up very well with Hitachi technologies in air compressors. This is why Hitachi has made the investment to be here directly to serve this market need.

### How are you taking the products to market?

Hitachi is a very distributor-oriented company. We make 100% of our sales through independent distributors within Hitachi Industrial — on a global basis. We are actively in the process of setting up a complete distributor organization in North America. We have no intention or desire or history of setting up direct factory stores. The response (as you can see by the turnout for the inauguration) has been very strong from U.S. and Canadian distributors.

### I can see the strong response from distributors. That was a big golf outing yesterday!

Absolutely! Hitachi has a wonderful corporate view of how business life should be. The company emphasizes three cultural elements: harmony, sincerity and pioneering spirit. Harmony in business relationships is strongly emphasized. Harmony must be worked on as a goal with fellow employees, distributors, end users and vendors. Yesterday's recreational activities, like our golf outing and our dinner cruise, are seen as a way to build harmony.



Mr. Akira Suzuki holds U.S. and Japanese patents related to oil-free rotary screw compressors.



Mr. Yashiro Takeuchi and Mr. Bill Porter

**Can you give an example of the sincerity culture?**

Sure. Hitachi is an incredibly vertically integrated company with focus given to the product groups. The Air Technology group of products has its own organization within Hitachi, with a focus on compressed air systems. Beyond the product groups, there is a tremendous amount of synergy in operations and planning. This is where the sincerity culture comes into play. I've never seen such integration of operations. One factory makes pumps, motors and inverters in the same location. The manufacturing efficiencies are tremendous. Although each product group has its own financials to look after, the cooperation and collaboration is very strong and benefits everyone.

Hitachi air compressors are a great example of the vertical integration of the company. We manufacture 80% of what is in the cabinet. No one else in the world does this. Hitachi manufactures the scrolls, the rotary screw air-ends, the electric motors, the drives, the inverters, the microprocessor controllers — even the sheet metal. It takes a culture of cooperation and collaboration to make this happen.

**How about the culture of a pioneering spirit?**

The foundational credo of Hitachi is to “Contribute to Society through Technology.” The development of new technologies, therefore, is the primary focus of our pioneering spirit. The company was founded in 1910 as a machine repair shop at the Kuhara Mining Company in Ibaraki Prefecture, Japan. The spirit of innovation started with the founder, Mr. Namihei Odeira, who invented the company's first product: a five-horsepower electric motor.

This pioneering spirit is certainly evident in our air compressor business, where we hold many patented and truly innovative technologies. The first Hitachi air compressor was built in 1911. Since then, Hitachi has been a pioneer in the development of lubricated and oil-less reciprocating compressors, lubricated and oil-free rotary screw compressors and lubricated and oil-less scroll compressors.



Hitachi Oil-less Scroll Compressor

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## HITACHI AMERICA

### Please describe your oil-less scroll business.

Using our pioneering spirit, Hitachi was the first company to take scroll technology and use it in air compression. This happened in 1985 with a lubricated scroll compressor. Hitachi had first developed the scroll technology for refrigeration compressors in 1983. Over time, the small footprint, the sound attenuation, and the simplicity made it a successful technology for air compressors. The average dba rating is between the high 50s and low 60s, depending upon size. In 1995, we developed the oil-less scroll compressor and have been taking marketshare away from oil-less reciprocating compressors and oil-lubricated rotary screws ever since.

We manufacture four models: 2, 3, 5 and 7.5 horsepower oil-less scrolls. There are several advantages over rotary screw compressors. Since there is no lubrication system, there are no oil change-outs, and the result is less maintenance. They also turn on/off instantaneously with very low torque on start-up. Rotary screws ramp up more slowly. At these smaller sizes, this is a common working condition. It is better than rotary — due to less maintenance than rotary. There is no sump, no lubrication system (other than a couple sealed bearings) and, therefore, no oil change-outs. We have a 20,000-hour life expectancy for the scrolls.

The 7.5 hp model is the largest oil-less scroll in the world. We are the only manufacturer in the world with a 7.5 hp scroll. We are investing in plans to go larger and already have larger units in operation in Japan. For larger systems,

we provide our oil-free rotary screw compressors. “Multi-plexing” (packaging multiple scrolls into one unit) is not our strategy. We find that multi-plexing strategies can be a result of manufacturing and design limitations.

### Please describe your oil-free rotary screw business.

Hitachi began in 1967 with the design of its first oil-free rotary screw compressor. This first model was a 450 kW two-stage model. We have since completed a full product range and have manufactured more than 15,000 units. As part of the first phase of our strategy, the oil-free rotary models we have in stock are 20 through 125 hp for next-day shipments. The 20-75 hp single-stage models are available as both fixed-speed and variable-speed units. We have two-stage units from 30-125 hp available. We offer both air and water-cooled units as well as VSD on the larger two-stage units.

Hitachi has been very innovative with the designs of its oil-free rotaries. The rotors are made of stainless steel in both the first and second stages. We are the only manufacturer in the world to use a PTFE-free coating material on the rotors. The units actually carry several U.S., German and Japanese patents covering the rotor design, the pre-cooler, oil-mist remover, capacity control design, interstage air purging and a two-step speed reduction system (patent pending). To get the details, we invite you to one of our training sessions!



Mr. Kevin DiSanto and Mr. Joel Sparnon of Hitachi America's Air Technology Group.



Hitachi Oil-Free Rotary Screw Air-End

**You are also selling blowers, right?**

Yes. Hitachi manufactures 100% oil-less regenerative vortex blowers. The design can provide positive pressure or suction. We have two product lines in inventory, a high-volume product and a high-pressure product line. The Hitachi blowers were brought as an OEM product originally. They are great solutions for the misapplications of compressed air — such as when compressed air is regulated down. The more people do audits and understand the uses of compressed air, the more application opportunities appear. The model sizes we carry in inventory are from 1/8 hp to 20 hp.

**What plans does Hitachi have for a “phase two” expansion in North America?**

We are focused on supplying oil-free and oil-less air compressors from 3 to 125 hp in North America. We will certainly be deciding in the future what further models and designs we will begin keeping in inventory. We will be looking hard at expanding the inventory of two-stage oil-free rotaries (VSD and fixed-speed) up to 300 hp. Longer term, we will evaluate other products, such as our lubricated rotary screw compressor line from 5 to 350 hp.

**Thank you, Mr. Shanbhag, for your insights.**

For more information contact Mr. Nitin Shanbhag at tel: 704-494-3008, email: [nitin.shanbhag@hal.hitachi.com](mailto:nitin.shanbhag@hal.hitachi.com), [www.hitachi.us/airtech](http://www.hitachi.us/airtech).

**Hitachi Fast Facts\***

**Net Sales:** \$83.6 billion

**Employees:** 355,879

**Fortune Global 500 Ranking:** #38

1000 Affiliated Companies

**Hitachi Industrial Equipment Systems**

**President and Director:** Mr. Kiyohiko Shiiki

**Net Sales:** \$1.1 billion

**Employees:** 4,600

**Products:** Air compressors, electric motors, inverters, PLCs, servo drives, blowers, water pumps, inkjet printers, transformers, switches, hoists

\*2006 Estimates — varies with exchange rates

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“Using our *pioneering spirit*, Hitachi was the first company to take scroll technology and use it in air compression.”

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# B E L A I R T E C H N O L O G I E S

*Compressed Air Best Practices interviewed William B. Thomas (president) of BelAir Technologies.*

**Good afternoon. Please tell me about your background with compressed air.**

Good afternoon. I have worked in the compressed air industry for 23 years. I started with Hankison Corporation in 1984, where I served as president from 1987 to 1994. I then worked as president of Van Air Systems in 1995 and 1996 and was president at Wilkerson Corporation from 1997 to 2001. When Wilkerson was sold to Parker Hannifin in 2001, I founded BelAir Technologies.



*Inventory in Delaware Warehouse*

### What led you to start BelAir Technologies?

At Wilkerson, we developed a good private label business with refrigerated dryers being sold to air compressor manufacturers. Wilkerson's supplier for the specialty high inlet temperature dryer was an Italian company called Friulair. Friulair proved to be a reliable and high quality supplier. We developed a business relationship, and when Wilkerson was sold to Parker, I decided to work with them to bring Friulair refrigerated dryers to the U.S. and Mexico. BelAir Technologies was incorporated in May 2001, and we are now entering our seventh year.



### What is BelAir known for?

We focus on the speed of delivery of our full range of products. We ship from inventory from geographically strategic locations in Delaware, Colorado and Chicago. These three warehouses allow us to ensure arrival of refrigerated dryers at the customer's site within two days in 95% of the continental United States. We are also very responsive in our service support through these locations. All maintenance and service parts used on our products are available at these facilities.

Fast deliveries can really help an end user get through a problem situation where a dryer has broken down. Our distributors know they can count on our fast deliveries when their customers are in a bind.

**Table 1: BelAir Technologies' Focus on Deliveries**

PRODUCT LINE	RANGE	DELIVERY	FOB POINTS
Refrigerated Dryers	To 2000 scfm	From stock	Colorado, Delaware
Refrigerated Dryers	To 200 scfm	From stock	Chicago
Desiccant Dryers (Heatless)	To 1000 scfm	3 days	Colorado, Pennsylvania
Filters	Full Line	From stock	Colorado, Delaware
Condensate Drains and Oil-Water Separators	Full Line	From stock	Colorado, Delaware
Custom Refrigerated and Desiccant Dryers	To 20,000 scfm	Built-to-order	Pennsylvania

### What would you consider to be BelAir's core technical expertise?

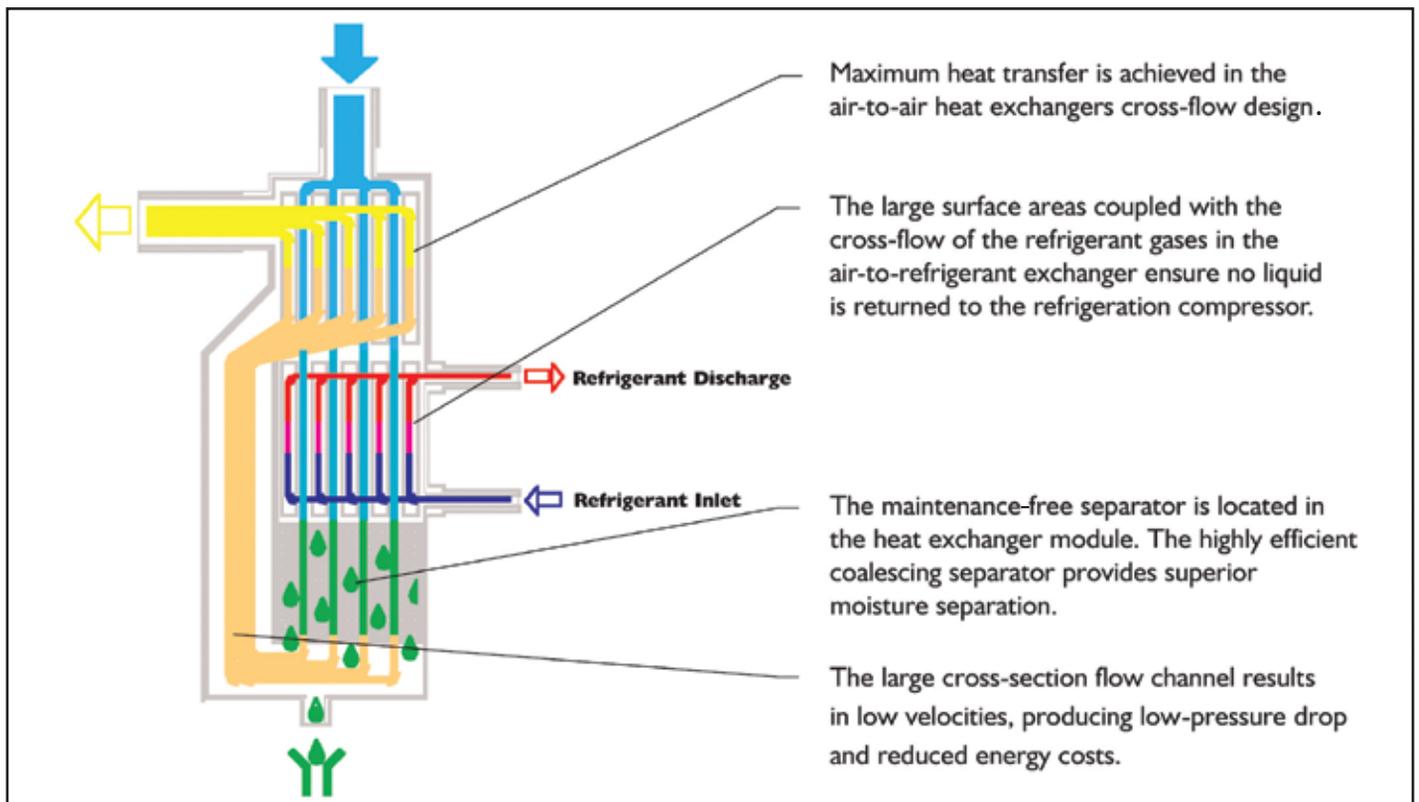
Refrigeration controls and innovative heat transfer technology applied to refrigerated air dryers is where we differentiate ourselves technically. We have developed some innovative processes and components in refrigerated dryers. The innovations are in refrigeration control valves and heat exchangers.

### Please describe the refrigeration control valve innovation.

Friulair Air Dryers co-developed with Danfoss refrigeration controls a proprietary constant-pressure hot gas bypass valve for the refrigeration circuit. The valve has a capillary-tube nitrogen bulb-dampening device which is strapped to the refrigeration inlet to the evaporator, which allows us to set the refrigeration temperature at 33 °F, with a refrigeration drift of only +/- 1/2 °F. The key is reducing the range that the refrigeration temperature can change (or drift) from the set-point. A refrigerated dryer design cannot allow the temperature to hit 32 °F because freeze-ups will occur. Up until now, most valves have historically had a drift of +/- 3 °F. This has forced dryer manufacturers to set the refrigeration temperature at a minimum of 36 °F. The minimal 1/2 °F drift of this valve technology allows us to set refrigeration temperatures at 33 °F. The refrigerants we use are R-134a on units up through 100 scfm and R-404a on units larger than 100 scfm. The benefit to the customer is consistently low-pressure dewpoints with environmentally-benign, CFC-free refrigerants.

“the Friulair refrigerated dryer is used where low dew points are important”

## BELAIR TECHNOLOGIES



### What is the innovation with the heat exchangers?

Friulair designs and builds the ACT heat exchangers exclusively for the application of drying compressed air. The proprietary ACT (aluminum cooling technology) heat exchangers have three significant features. The first is that the approach temperatures are between 2-3 °F in the ACT evaporator. Approach temperature is the temperature difference between the incoming refrigerant and the outgoing compressed air. It is a way to measure the effectiveness in heat transfer of a heat exchanger.

A low approach temperature means that the heat in the compressed air is being effectively transferred to the refrigeration gas within the heat exchanger. When you couple this with the low refrigeration temperature set-points, we are able to consistently deliver 35-36 °F pressure dewpoints. For this reason, the Friulair refrigerated dryer has become known as a dryer to use where a low and consistent dewpoint is important.

Many heat exchangers designed for other applications are used in refrigerated air dryers. Many have much higher approach temperature ranges. This is why some designs offer relatively high dewpoint ranges. We are so confident in the ability of our dryer designs to maintain a low dewpoint that we offer a remote alarm function which is activated if the dewpoint exceeds 38 °F.

**Table 2: Innovative Refrigerated Dryer Design**

DRYER DESIGN	BELAIR/FRIULAIR	INDUSTRY
Refrigeration Drift	+/- ½ °F	+/- 3 °F
Refrigeration Set-Point	33 °F	36 °F
Heat Exchanger Approach	2-3 °F	3-10 °F
Dewpoint Range	35-36 °F	39-46 °F

### What are the other two features of the heat exchangers?

We have the lowest average pressure drop across our product line of refrigerated air dryers. We publish the precise pressure drop for each model we manufacture. The pressure drops range from under 1.0 psid to 3.5 psid.

The third feature is that all wet surfaces in the ACT heat exchangers are vertical. The benefit of this is that no liquids are stored during low-flow periods. Moisture is drained by gravity in the vertical heat exchange compartments to where the condensate drains can evacuate the liquids. In contrast, horizontal heat exchangers can have liquid water sitting in them during low-flow conditions. When the system load increases, this liquid can slug the separator and drain and end up in the compressed air system.

Low-flow periods are present in virtually all compressed air applications. Compressed air is rarely used as a fluid process where flow is uninterrupted. Compressed air systems may run 85% loads during the first shift, 50% loads on the second shift and be used only for maintenance (and leaks) during the third shift, weekends and breaks.

### How does BelAir go to market?

Our primary channel to the market is through compressor distributors. We support our distributors with the timely deliveries we mentioned earlier and with quick sales and service support (on demand). We have a staff in Colorado and Delaware who take personal phone calls to promptly respond to sales and service needs.

### What training support is provided?

We bring service training to the distributor. Basic service training covers electrical circuits, controller programming and maintenance. We also offer the option for refrigeration training if the distributor is prepared for it. We have a mobile sales and service training trailer that travels around the country. The trailer is equipped with our refrigerated and desiccant air dryers and has an on-board generator to provide power to the equipment. Our regional sales representatives set up the training courses with the distributors.

Our dryers are also designed with service in mind. They have spacious cabinets, which provide easy access to components. Many components are snap-in, snap-out for easy and quick replacement. We do this, for example, with the condensate drains in the refrigerated dryers.



*BelAir brings sales and service training to distributor locations.*

## BELAIR TECHNOLOGIES



### Please tell us a little about Friulair.

Friulair is a leading manufacturer of refrigerated compressed air dryers. They are located in northern Italy, an hour north of Venice, in an area called Cervignano del Friuli. They were founded in 1990 by Mr. Luigi Vaccaro, who remains the sole proprietor and CEO. In 2006, Friulair manufactured over 17,000 refrigerated dryers. The facility has full lab testing capabilities up through 2500 scfm for refrigerated dryers. Friulair also owns a refrigerated dryer factory and marketing company in Bangkok, Thailand, to address the Asian market. The majority of Friulair's global marketshare is in Europe, with the Italian market its strongest. The brand is growing rapidly in Asia and now in North America. Friulair is represented in Canada by their strategic partner CAG. BelAir Technologies is responsible for the United States and Mexico.



*Friulair Dryer Factory in Italy*

### How has business been, and what plans does BelAir have for the future?

Growth has been strong since 2005 for BelAir Technologies. Many distributors have signed on with us due to our fast deliveries and the high quality refrigerated dryers. The consolidation of the air dryer industry has also created opportunities for BelAir, because some companies now build to order rather than build to stock.

In our upcoming future, BelAir Technologies plans to become more active in specialty engineered-to-order projects for compressed air treatment equipment. We are building these capabilities as we speak. We will also continue the effort to bring innovative value-added products and technologies to the standard lines of equipment.

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

For more information, please contact Mr. Bill Thomas, of Belair Technologies at 303-287-6666, email: [wthomas@belairtech.net](mailto:wthomas@belairtech.net) or visit the web site: [www.belairtech.net](http://www.belairtech.net).

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“Our distributors know they can count on our fast deliveries when their customers are in a bind.”

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## REAL WORLD BEST PRACTICES

# AIR-OPERATED DOUBLE DIAPHRAGM PUMPS

BY HANK VAN ORMER

## Introduction

The thought behind this section is to feature compressed air operated equipment found in most plants and outline the “Best Practices” for effective and efficient operation. Air Power USA, Inc. is a compressed air systems and equipment consultant company which does not sell equipment. We work in plants all over the world but predominantly North America. During our 20 years of measuring and evaluating compressed air systems, we have come to some very significant conclusions:

- Compressed air is the most expensive utility! It takes a minimum of 8 hp of electric power to create 1 hp of pneumatic power — yet most plants continue to treat it with less attention than water, electricity or steam.
- Many “compressed air audits” center on the supply side — compressors, filters, dryers, piping and capacity controls, and these are important and often a significant opportunity for energy recovery. However, we have formed the opinion that about 50% of the potential energy recovery is on the demand or using side. This is often ignored due to:
  - Lack of knowledge of the specific equipment and what can be done.
  - Inability during the audit to talk to the proper person who knows the details.
  - Each process by itself may seem small and insignificant until viewed as a total system, and then the order of magnitude is significantly higher.

Following this thought process has led us to believe a monthly feature on commonly used compressed air driven equipment and some of the better ideas or best practices we have found that work. Of course, in finding these, we also identify what not to do and what the cost of doing “Not Do’s” is. Sometimes you may have no choice except to operate inefficiently to meet productivity goals. In this case, an informed decision can only be made when you are aware of the alternative and the corresponding operating cost relationship.

Most often we find when efficiency programs are implemented in the production or other compressed air using areas, there is not only a significant energy reduction, but corresponding improvements in productivity and quality.

As this feature progresses, we invite readers to send in their comments and, most importantly identify any “Best Practices” ideas that work for you that we did not cover. In this issue, we will cover air-operated diaphragm pumps, and over the coming issues, we’ll review such things as cabinet coolers, effective selection and use of regulators, blow-off operation, air cylinders, Venturi vacuum generators, dry material conveying, etc.



AODD Clamped Pump Design  
(photo courtesy of Price Pump)

# REAL WORLD BEST PRACTICES

## AIR OPERATED DOUBLE DIAPHRAGM PUMPS

### Air-Operated Double Diaphragm Pumps (AODD Pumps)

Following are some ideas to consider before selecting an AODD pump or evaluating an existing installation. These are guidelines, not black and white yes or no. When selections on applications are made without these considerations, there is a very good chance for gross inefficiency. Some AODD pumps in your system were selected by you and some were supplied by OEM vendors with the machinery supplied. Did they use an appropriate application thought process?

### Understand How to Evaluate the Operating Energy Cost of an AODD Pump

When identifying how much air (cfm) it takes to run an AODD, the figures reflect some generally accepted volume demand levels. They are based on pumping H<sub>2</sub>O (or specific gravity of 1). As the viscosity gets heavier and/or the “head” builds up, the pressure requirement increases. When unregulated, the capacity requirement will fall.

Obviously, it is not that simple, but this is important to keep in mind. Most plants run at 85 to 95 psig, which is usually a very good inlet pressure for a pump and allows relatively high head with acceptable throughput. At lower head pressure, the cycle or strokes per minute (str/min) increases, which is directly proportional to the compressed air demand (cfm).

Figure 1

Nominal Pump Size	Air Pressure Range	Nominal scfm	Estimated Electric Pump HP
< 2"	65 - 100 psig (average 80 psig)	15 - 20	? hp - 1 hp
1"	65 - 100 psig (average 80 psig)	25 - 30	? hp - 1 hp
1 1/2"	70 - 100 psig (average 80 psig)	45 - 58	1 ? hp - 2 ? hp
2"	80 - 120 psig (average 95 psig)	90 - 120	3 hp - 5 hp
3"	90 - 100 psig (average 100 psig)	125 - 150	5 hp - 7 hp

Figure 2 shows the relationship between str/min and air volume flow requirement.

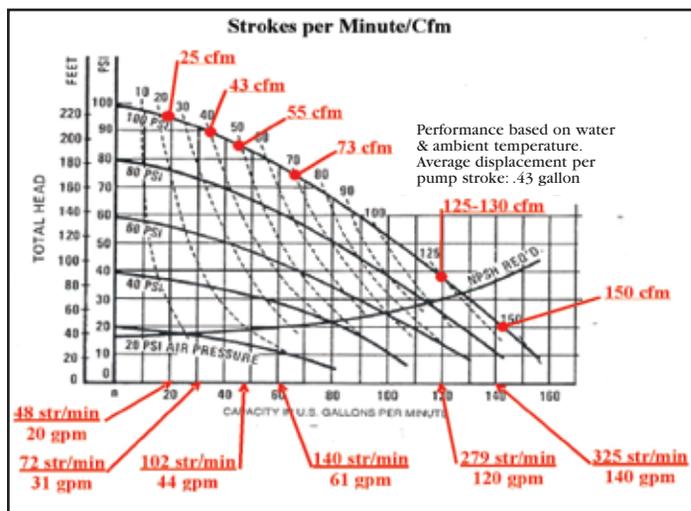
You will see a “generic 2 inch” AODD on the chart is listed as using 90–120 scfm with an average 95 psig inlet pressure. However, the only accurate way to identify the air use other than a flow meter is to count the cycles. Figure 2 shows that the actual variance of the pump is from 25 scfm to 150 scfm, directly dependent on the cycles.

Keep these operating characteristics in mind as we progress through additional guidelines. By the way, before making an informed decision, you need to know your energy cost per scfm per year, (\$??/scfm/yr). DO YOU?



A 2" 316 SS bolted design AODD Pump (courtesy Price Pump)

Figure 2



### Is a Diaphragm Pump the Proper Selection?

Diaphragm pumps have many very desirable operating characteristics:

- Can be designed to handle aggressive chemical or physical product throughput.
- Are relatively insensitive to running empty without catastrophic failure.
- Quick to fix or repair.
- Will automatically adjust to significant head pressure increases as long as the pressure is available and the str/min is acceptable.

On some processes, none of these may be important, and an AODD was selected because they utilize a very forgiving design. Be sure you look at other types: variable displacement, reciprocating, centrifugal, etc.

### Why Air Driven?

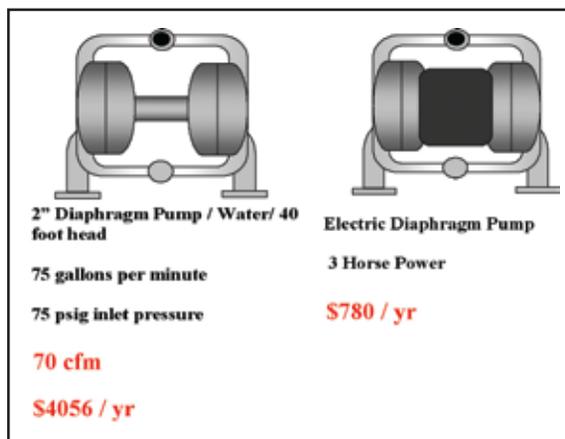
If an air-driven pump was selected only because:

- It was simple
- Did not have to run electric power to the location
- Dirty, hostile atmosphere, etc.

You may have missed an opportunity.

Be sure you consider or will consider an electric motor driven pump (including diaphragm type). Figure 3 shows the magnitude of potential savings on a continuously running (8760 hours/yr.) with average performance pumping product with a specific gravity of 1 (water).

Figure 3



A word of caution — as the head pressure increases, the input energy required to the electric-driven pump increases. The str/min of the air-driven pump will decrease as long as the available pressure in the plant is high enough. Do your evaluations with good data input! Under high head conditions and acceptable str/min, the air-driven pump may actually be more cost effective.

**Batch Pumping or Pumping Continuously?**

Does the pump run continuously because it can? YES, that's the neat part about an AODD. It can run on empty and continue to operate and pump product as it receives it.

However, as the load falls, the str/min goes up, and thus the higher air usage is at no load. See Figure 2.

Figure 4 compares a typical batch pumping system's annual electrical energy operating cost to that of a continuous pumping system. This projected savings is a very conservative one.

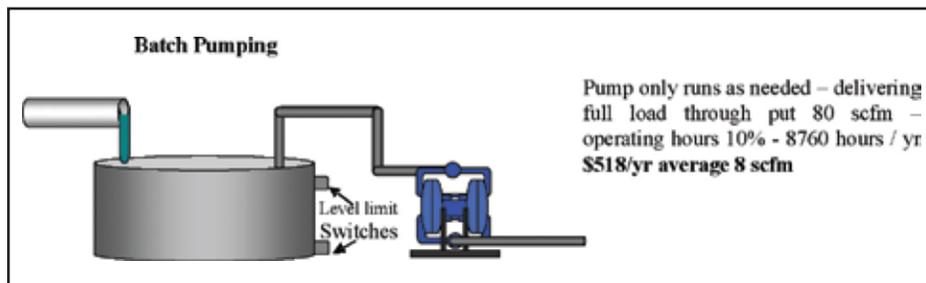
The actual cost is driven by:

- The batch pump always running at full load (lowest possible air demand without controls) and;
- Shutting off pump is actually only on 10% of the time (the best data shown here is from an actual plant air system evaluation).

Using a 2" pump continuously running with an average demand of 80 scfm and the batch pump at 80 scfm also, we calculate an annual electrical energy cost at \$0.05 kWh at 6240 hours per year (80 scfm is about 20 hp/1.66 kW)

In a nutshell, batching (\$518/yr.) versus continuous (\$5180/yr.) will always be a "no brainer" if it can be implemented. Before you say you can't afford to modify the system, be sure you know the true cost in RECOVERABLE ENERGY COST.

Figure 4



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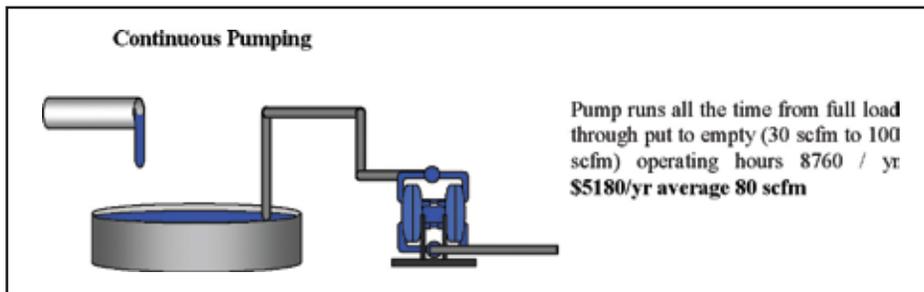
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# REAL WORLD BEST PRACTICES

## AIR OPERATED DOUBLE DIAPHRAGM PUMPS



### AODD Controlled vs. Uncontrolled

No air-operated equipment, especially AODDs, should run uncontrolled.

### Inlet Pressure Control

Is the pump running most of the time at the lowest possible pressure? The higher the pressure, the most air is used. For example, filter-packing operations often do not need

high pressure except during the final stages of the filter packing cycle. Controls can be arranged to generate lower pressures in the early stages and higher pressures later on, which may generate significant savings. Lower inlet pressure means lower overall flow on an uncontrolled AODD.

### Cycle or STR/MIN Control

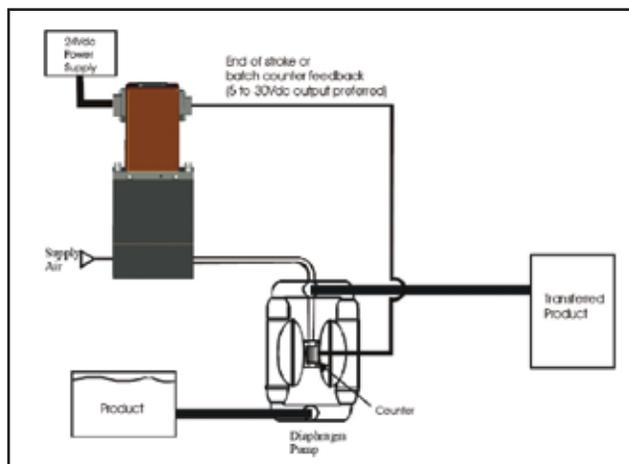
This is obviously potentially the most effective optimizer there is. Control the cycle to lowest and proper speed to assure a full transport line of product while using the least amount of air. Over the years this has been tried with back pressure regulators, manual controls, etc. One of the basic drawbacks has always been that as the cycles are cut back, it tends to reduce the pump efficiency, and when conditions change, the inefficiency may worsen.

### Using Microprocessors with Appropriate Internal Software to Control

Recently, a new product to control AODDs has been introduced called “Miz Air.” This is a special high-volume, high speed (35 milliseconds to open/35 milliseconds to close) air-piloted dispensing valve.

This valve is controlled by a microprocessor which analyzes the stroke frequency and throughput flow characteristics to determine the proper and lowest cycle rate to optimize throughput. Once established, it then shuts off the air supply during the stroke and allows the product flow and pump inertia to complete the stroke without any additional air flow. It then opens again, etc. The net results are:

Figure 5



- At the same input pressure, the compressed air usage falls 35 to 50% (stroke and cycle rate falls)
- Product throughput per stroke increases the average product flow per scfm increases significantly — 50–100%

This is another example of utilizing modern microprocessors and modern fast acting control valves instead of older spring and diaphragm controls and having significant potential to lower our industrial operating energy costs.

Mr. Hank Van Ormer is a leading compressed air system consultant who has implemented over 1200 air improvement projects. He can be contacted at tel: 740-862-4112, email: hankvanormer@aol.com, and www.airpowerusainc.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, for this column was gathered during the trading day of June 26, 2007.

**Fu Sheng Industrial Co., Taiwan, May 9, 2007** — Valiant International Co., Ltd. (“Valiant”), a Taiwan company newly established by investment funds managed by Oaktree Capital Management, LLC (“Oaktree”), has launched a public tender offer to acquire 100% of the outstanding common shares of Fu Sheng Industrial Co., Ltd. (“Fu Sheng”) at a per share price of NTD 37.50 in cash. The offer price represents a premium of approximately 15.7% over the average 30-day closing price of Fu Sheng shares on the Taiwan Stock Exchange, and a P/E multiple of 14.3x Fu Sheng’s consolidated net income per share in 2006. The tender offer will be for a period of 50 days and subject to a minimum acceptance condition of 51% of the outstanding Fu Sheng shares (i.e., 384,478,000 shares) and governmental approvals. Fu Sheng is the parent company of **Curtis Compressor** and **FS Elliott**.

Upon completion of the tender offer, Valiant plans to effect a cash merger with Fu Sheng with Valiant as the surviving entity and Fu Sheng being the dissolving company at an effective per share price equal to the tender offer price, which will be adjusted to take into account 2007 cash and share dividends that Fu Sheng shareholders become entitled to prior to the record date set for the closing

of the cash merger. The total acquisition price will be approximately NTD 28.3 billion, or approximately US\$852 million at an exchange rate of NTD 33.2 per US dollar. Including the assumption of net debt, the total enterprise value is approximately NTD 33 billion, or approximately US\$1 billion.

**Mr. Lee Hou Teng**, founder and chairman of Fu Sheng, and a number of his family members, who collectively own approximately 46.8% of the outstanding shares of Fu Sheng, have agreed to tender their shares to Valiant in the tender offer and reinvest a substantial portion of the net proceeds from such sales in a holding company (“Parent”) that will own 100% of the equity interest in Valiant. Such reinvestment in Parent will be made at a subscription price equal to the subscription price paid by the Oaktree funds. The Lee family members are expected to own an aggregate equity interest in Parent that is generally the same as their current ownership of approximately 46.8% in Fu Sheng. Chairman Lee will continue as chairman of the surviving company after the merger following the transaction and Fu Sheng’s senior management are expected to remain in place.

“This transaction marks an important milestone in Fu Sheng’s operating history,” said Founder and Chairman Lee. “Over the last several years, Fu Sheng has successfully established itself as a leading manufacturer of golf club heads and air compressors in Asia. I am confident that this commitment of capital and resources by Oaktree will help Fu Sheng execute its long-term growth strategy and will enhance Fu Sheng’s competitive position in the global market. A partnership with Oaktree gives Fu Sheng an excellent opportunity to enhance its core business operations and complete its transformation into a truly global company with an internationally-recognized brand name, but firmly based in Taiwan.”

Lee continued, “Oaktree has an outstanding track record of helping companies like Fu Sheng execute their global growth strategies. Fu Sheng’s senior management team will remain intact but additional key resources will be added to help lead our enterprise into the future. I believe this transaction will provide further growth opportunities for our valued employees, who are responsible for the success we have enjoyed over the years, and better allow us to serve our customers. I am confident that a partnership with Oaktree will help ensure Fu Sheng’s continued success.”

## WALL STREET WATCH

According to Bill Kerins, Managing Director of Oaktree Capital (Hong Kong) Limited, "We are excited about the prospect of partnering with this well-established, solidly-run company. Fu Sheng is a strong, stable business that has delivered consistent growth over time. We see this transaction as part of a broader strategy to assist Fu Sheng in achieving its long-term strategic goals and growing its operations globally."

**CHARLOTTE, NC — May 2, 2007 — SPX Corporation** (NYSE:SPW) today reported results for the first quarter ended March 31, 2007.

Revenues increased 13.0% to \$1.08 billion from \$0.95 billion in the year-ago quarter. Organic revenue growth was 7.7%, while completed acquisitions and the impact of currency fluctuations increased reported revenues by 2.3% and 3.0%, respectively.

Segment income and margins were \$105.3 million and 9.8%, compared with \$82.5 million and 8.7% in the year-ago quarter. The increase in segment income and margins was driven by improvements across each of the company's four business segments.

Diluted net income per share from continuing operations (the basis of the company's guidance) was \$0.55, compared with \$0.38 in the year-ago quarter. The effective tax rate for the quarter was 34.3%, slightly below the company's previous expectations of 35% to 36%. The company's updated expectation for the 2007 effective tax rate is 33% to 34%.

Net income was \$29.2 million, or \$0.49 per share, compared with \$21.7 million, or \$0.35 per share in the year-ago quarter.

Net cash used in continuing operations was \$15.1 million, compared with \$114.2 million in the year-ago quarter. Free cash flow from continuing operations was a negative \$27.2 million, compared with a negative \$124.4 million in the year-ago quarter. The first quarter of 2007 included an advanced tax payment of \$37.5 million, while the first quarter of 2006 included a payment of \$84.3 million related to accreted interest on the redemption of convertible notes.

**Chris Kearney**, president and CEO said, "SPX's first quarter performance marked a strong start to 2007. We achieved or exceeded our operating targets for organic growth, margin improvement and earnings, highlighted by a 45% increase in earnings per share from continuing operations."

Kearney continued, "We have also made progress from a strategic and capital allocation perspective, completing the sale of our Contech automotive components business and returning capital to our shareholders by repurchasing 3.0 million shares of our common stock for \$210.6 million year to date."

"In addition, we are raising our earnings per share guidance range to \$4.45 to \$4.65 from the previous range of \$3.85 to \$3.95. This 17% increase is driven by multiple positive factors: our continued robust order trends in global infrastructure, particularly power and energy markets, our ability to execute on this demand through a constant focus on our operating initiatives, our recent share repurchases, and a lower effective tax rate due to our expanding global presence," Kearney concluded.

**Flow Technology Business Segment**

Revenues in the first quarter of 2007 were \$274.4 million, compared to \$218.0 million in the first quarter of 2006, an increase of \$56.4 million, or 25.9%. The increase was due to organic revenue growth of 10.7%, growth from the fourth quarter 2006 Custos acquisition of 11.6% and currency fluctuations of 3.6%. The organic growth was related primarily to continued strong demand in the power, mining, oil and gas and dehydration markets. **SPX Dehydration and Process Filtration** is part of the Flow Technology Business Segment.

Segment income was \$37.6 million, or 13.7% of revenues, in the first quarter of 2007, compared to \$28.0 million, or 12.8% of revenues, in the first quarter of 2006. The increase in segment income and margins was due primarily to the organic growth noted above and efficiencies achieved from continuous improvement initiatives.

**Share Repurchases:** During the first quarter of 2007, the company repurchased 2.3 million shares of its common stock for \$164.7 million. Year-to-date through May 2, 2007, the company has repurchased 3.0 million shares of its common stock for \$210.6 million.

**Dividend:** On June 1, 2007, the company announced that its board of directors has declared a quarterly dividend of \$0.25 per common share payable on July 2, 2007, to shareholders of record on June 15, 2007.

**Hamilton, Bermuda, May 31, 2007 — Ingersoll-Rand Company Limited's** (NYSE:IR) chairman, president and chief executive officer **Herbert L. Henkel** today will describe the company's progress in executing its transformation strategy during the Sanford C. Bernstein Strategic Decisions Conference in New York, NY.



“In 2000 we began a process to transform Ingersoll Rand into a diversified industrial firm capable of delivering consistently improving financial performance across all phases of the business cycle,” Henkel said. “In pursuing this goal, we have divested heavy-machinery, capital-intensive businesses, and completed approximately 65 bolt-on acquisitions of businesses whose growth, market and operational characteristics offer the prospect of consistent financial performance over the long term.

“Our recent announcement to explore strategic alternatives for our Bobcat, Utility Equipment and Attachments businesses represents a continuation of Ingersoll Rand’s transformation. At the conclusion of the process, which may include an outright sale of these businesses or a spin-off to shareholders, Ingersoll Rand’s global growth platforms will consist of businesses providing customer solutions for climate control, industrial productivity and security. These businesses are well positioned to deliver the growth and financial returns expected from a leading diversified industrial company.”

In keeping with the company’s transformation, Ingersoll Rand’s financial results will now be reported in three segments: Climate Control Technologies, Industrial Technologies (including Club Car), and Security Technologies. The Bobcat, Utility Equipment and Attachments businesses are expected to be reclassified as discontinued operations.

“I am also pleased that our board of directors continues to express their confidence in our ongoing transformation. On May 14, 2007, the board approved the expansion of its share-repurchase authorization, which was originally announced in December 2006, from \$2 billion to \$4 billion. We plan to accelerate the repurchase program to complete \$2 billion of share repurchases by the end of the 2007 third quarter.” Approximately \$330 million in shares had been repurchased as of early May 2007 under the original authorization.

The timing of the remaining \$2 billion of the share repurchase authorization will depend on the disposition of the Bobcat, Utility Equipment and Attachments businesses, as well as other uses of cash in conjunction with the company’s acquisition program.

“We have tremendous flexibility in executing our strategies to enhance shareholder value as the result of our strong annual operating cash flow, the prospective proceeds from the sale or spin-off of the Bobcat, Utility Equipment and Attachments businesses, the proceeds of more than \$1 billion we received from the recent divestiture of our Road Development business, and our strong balance sheet. We will continue to execute share repurchases and pursue growth through strategic acquisitions.”

JUNE 26, 2007 PRICE PERFORMANCE	SYMBOL	LAST PRICE	1 MONTH	6 MONTHS	12 MONTHS
Parker-Hannifin	PH	\$97.97	0.0%	28.0%	31.2%
Ingersoll Rand	IR	\$54.07	12.8%	43.0%	33.9%
Gardner Denver	GDI	\$41.19	3.6%	14.1%	25.4%
United Technologies	UTX	\$70.57	3.9%	13.9%	14.4%
Donaldson	DCI	\$35.44	-4.7%	1.4%	8.3%
EnPro Industries	NPO	\$42.69	6.3%	29.3%	25.8%
SPX Corp	SPW	\$86.23	1.9%	41.5%	57.2%

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## WALL STREET WATCH

**Parker Hannifin Corporation (NYSE: PH), Cleveland, June 5,** today reported that total orders for the month of May remained unchanged compared to orders in the same month a year ago. Orders are calculated as a percentage increase over the prior year using a daily average. In addition, Parker reported the following orders by operating segment:

- Orders decreased 10 percent in the Industrial North America segment versus May a year ago.
- Orders increased 13 percent in the Industrial International segment versus May a year ago.
- Orders increased 11 percent in the Aerospace segment on a rolling 12 month average basis.
- Orders decreased 15 percent in the Climate and Industrial Controls segment versus May a year ago.

May 2007 contained one additional work day in North America versus May 2006, negatively impacting the daily average comparison.

**United Technologies Corp. (NYSE:UTX) HARTFORD, Conn., June 13, 2007** — The Board of Directors today approved a 21 percent quarterly dividend increase to 32 cents per common share. The dividend is payable September 10, 2007, to shareowners of record at the close of business on August 17.

“UTC has nearly tripled its dividend in the past six years,” said Chairman and Chief Executive Officer **George David**. “The board’s action today reflects consistently strong cash flow and affirms our confidence in sustained earnings growth.”

UTC has paid cash dividends on its common stock for 71 consecutive years dating to 1936.

**EnPro Industries (NYSE:NPO) Charlotte, N.C., June 20,** announced the acquisition of Texflo Machining Ltd., a privately-held company that services and repairs reciprocating compressors, primarily for the natural gas market in Western Canada. The transaction was completed for cash; terms were not disclosed.

Headquartered in Edmonton, Alberta, Texflo rebuilds compressor cylinders and engine components and machines parts specialized to withstand harsh conditions. The business also offers thermal spray coating technologies for compressor and industrial applications and manufactures compressor rods and pistons.

“Texflo is an excellent complement to our France Compressor Products business,” said **Ernie Schaub**, EnPro president and chief executive officer. “The acquisition expands our product offerings to the natural gas compression market and extends our ability to serve the markets of Western Canada. Texflo’s reputation for superior performance, advancements in technology and product development align well with EnPro’s culture and strategic direction.”

“We are known for producing products and solutions that meet some of the most severe conditions the oil and gas industry has to offer,” said George Ramsay, Texflo’s principal owner. “We’ve developed a reputation as an industry leader. By joining with France Compressor Products, we gain the benefit of a larger, more established sales and marketing force and the opportunity to accelerate our growth, both in Canada and in the United States.”

Texflo, which employs 40 people, will be managed as part of France Compressor Products and will continue to manufacture products and market its services from its facilities in Edmonton and Grande Prairie, Alberta. France Compressor, headquartered in Stafford, Texas, has other Canadian operations in Medicine Hat, Lac La Biche, Edmonton and Calgary, Alberta, as well as Brantford, Ontario.

# Special Report:



## THE 2007 A.I.C.D. BY ROD SMITH

Sometimes one is forced to take one for the team. You have to take on the tough assignment yourself because, well, someone has to do it. So it was with me in late May when I ventured out to San Antonio, Texas, and braved the rigors of the La Cantera Resort for the 22nd Annual A.I.C.D. Membership Meeting and Exhibition.

Founded in 1985, the A.I.C.D. has grown to over 75 members in the United States, Canada, Mexico and other countries. The A.I.C.D. provides its membership with cooperative purchasing programs, member training and educational seminars. Additionally, our annual meetings provide networking opportunities with other distributors and vendors within the compressed air industry. Visit [www.aicd.org](http://www.aicd.org)

Joining me at the meeting were more than 200 A.I.C.D. members and exhibitors. The president of the A.I.C.D., Ron Nordby of John Henry Foster Minnesota Inc., commented that the objectives of the organization and the meeting are to “help member companies grow, expand and make their companies more profitable. We try to expose members to new ideas and new product lines and supply a forum to gain ideas from each other.”

A.I.C.D. member companies sell and service air compressors. Members come from all over North America, Latin America and Mexico. Speakers and vendors are invited to help generate discussion, training and ideas to help member companies operate their businesses.

I missed the golf outing on Sunday due to my respect for the game of golf. The course at La Cantera hosts an annual PGA Tour Event, and I didn't want to dishonor the links — or hurt any innocent people. I did man a booth that evening for *Compressed Air Best Practices Magazine* at the exhibition. The exhibition hall was sold out of booth space and was filled with compressor distributor principals and managers taking a look at the latest ideas and technologies. I snuck out of my booth from time to time and put on my roving reporter suit.

The vendors at the exhibit on Sunday and Monday evenings represented a variety of different types of manufacturers. Compressed air treatment companies who manufacture dryers, filters and condensate management products were well represented. There were also fluid cooling and chiller manufacturers present. Manufacturers of piping, measurement instruments, FRL's, compressor control systems and receiver tanks also displayed their products. Other exhibits included blowers, field-service software providers, capital financing providers and wireless remote monitoring products.



Matt Zorn of Zorn Compressor & Equipment with MTA's Don Joyce and Howard Kielar (left to right).



Ed Ball of Process Air Solutions displayed regenerative and centrifugal blowers.

## SPECIAL REPORT: THE 2007 A.I.C.D.



Dale Alexander, Dave Gaitsch, Chris Nelsen, Bob Fisher and Jeff Dal Porto at the ZEKS booth (left to right).



Arnie Thompson, Allan Hoerner and Dale Zimmerman of Parker Airtek (left to right).



Robert Sturdy of Summit Industrial Products.

The speaker program covers two full days and is an important part of the A.I.C.D. Conference. Ron Nordby said of the speaker program, “The program brings in people from our industry to talk about real problems and solutions for our businesses. We also use our members to talk about actual projects and the strategies and techniques used, like system diagrams, to execute them.” The first day’s program covered the topic of diversification, while the second day was on rotary screw air compressors.

I had the opportunity to begin Monday’s session by speaking about “The Value of Diversification.” The idea here is not to diversify into selling volleyballs at the beach, but to sell more products to your existing customers using your existing sales force. This allows you to visit a customer more often than if you only sell air compressors. Over the past year of interviews, I have found many firms who have strengthened their customer relationships (and helped their compressor sales) by also selling blowers, vacuum, nitrogen generators and fluid cooling systems. Paul Richards of Sensicast Inc. then followed with a presentation of his firm’s wireless technologies, which can be used for energy-monitoring solutions. Capturing data from the compressed air system piped all over a plant can be difficult and expensive to do with hard-wire solutions. Mr. Richards presented the wireless sensors and communications devices from Sensicast to enable capturing flow, pressure and temperature measurements.

### A.I.C.D EXHIBITOR LIST

Air Supply Company	Direct Capital
Air System Products	Parker Domnick Hunter/Zander
AirTak	Donaldson
AKG Thermal Systems	Great Lakes Air Products
Case Engineering	Hankison
Chicopee Engineering	Hydrothrift
Clean Resources	Jorc
Compressed Air Best Practices	Legris-Transair
Cosa Instrument Company	Manchester Tank
CPI Engineering Services	McIntire/Arrow Dryers

Fred Muhitch, president of Thermotech, followed with an interesting presentation on fluid cooling systems. He covered a number of energy-saving projects and walked the group through the process by which energy savings are calculated and ROI scenarios are presented to customers. Market diversification can also be healthy for a company. A presentation on how to sell medical compressed air and vacuum systems was presented by Patrick Lorenz and Brian Antony of the Rogers Machinery Company and of John Henry Foster Minnesota, respectively. Both told of their experiences in going from a cold call to building a strong business relationship with major healthcare providers with multiple facilities.

Tuesday's session focused on air compressors. The president of Quincy Compressor, John Thompson, made a presentation. Chris Beals, president of Air System Management, reviewed the information he had published on variable speed drive air compressors. Dean Smith, president of iZ Systems, discussed how to integrate VSDs in a compressed air system. He also explained how to apply compressor control options to maximize the efficiency of VSD compressors within the air system. The day's final speaker was Sean Hoyt from S2000 Field Service Solutions, who demonstrated their S2000win software package, designed to improve the efficiency and profitability of distributor service departments.

The A.I.C.D. also finds some time to feed and entertain attendees. The event organizer and meeting planner, Cheryl Kiker, not only organized a flawless meeting but created an entertaining Monday night casino event and Mexican dinner buffet. My only advice to companies is — get involved! Next year's meeting is scheduled for May 18–20, 2008, in Hilton Head, South Carolina.

*For more information, please contact Ms. Cheryl Kiker, A.I.C.D., 3458 S. Pine Island Road, Beaumont, Texas, 77713, Phone & Fax: 409-866-1565, email: aicd@aicd.org.*

Midwest Control	SKF
Motivair	Solberg
MTA	Steel Fab
Numatics	Summit Industrial
Parker Airtek	Thermal Transfer
Parker Finite	Thermotech
Pingel Exchanger Service	Ultra Air
Process Air Solutions	Ultrachem
S2000 Field Service Solutions	Vaisala
Sensicast Systems	ZEKS

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# INDUSTRY NEWS

Press Releases

## BEKO INSTRUMENTS GMBH FOUNDED — BEKO GROUP EXPANDS RANGE OF SERVICES



On February 26th 2007, BEKO Instruments GmbH, Neuss, Germany, was founded.

BEKO TECHNOLOGIES GmbH, Neuss, and Mr. Andreas Teichmann are the associates. Mr. Teichmann is also the managing director of the new company, which takes over the activities of Workline Process Controls GmbH, Meerbusch, Germany.

Workline was founded 8 years ago by Andreas Teichmann. The company develops, manufactures and distributes measuring instruments for the registration of elements in compressed air and compressed gases. This predominantly concerns the registration of oil, moisture, particles and other gas components. In these markets, the company has achieved the reputation of an innovative provider. Four professionals are currently employed.

OILCONTROL, which is able to permanently and reliably measure and record residual oil contents of up to 0.001 mg/m<sup>3</sup> in compressed air, is an absolute highlight in the range of products. This device is unique on the global market. Previously, such low residual oil contents could only be measured reliably with great efforts on lab scale.

Another important product is MEDBAC, a monitoring system for breathable air supply units, e.g. in hospitals. MEDBAC measures the quality of compressed air in accordance with the guidelines of the "Pharma Copeea" and controls the oil content, moisture and CO<sub>2</sub>, SO<sub>2</sub>, CO, O<sub>2</sub> and NO<sub>x</sub>. In addition, the delivery program includes pressure dewpoint and particle measurement devices, as well as flow meters.

The future task sharing within the BEKO group envisages that BEKO Instruments develops and manufactures the measuring devices and that the national and international BEKO sales and service associations take over consulting, distribution and technical services.

For further information:  
BEKO TECHNOLOGIES CORPORATION  
236 RACEWAY DRIVE, STE. 1  
MOORESVILLE, NC 28117  
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www.bekousa.com



Berthold Koch (BEKO) and Andreas Teichmann (BEKO INSTRUMENTS).

## EPA HONORS SPX WITH TWO AWARDS



### **SPX and engineering manager honored**

The U.S. Environmental Protection Agency (EPA) honored SPX and one of its engineering managers with two prestigious awards for their work in reducing atmospheric pollution caused by the release of R-134a refrigerant. Commonly used in automobile air conditioning units, R-134a refrigerant is classified as a greenhouse gas. This refrigerant gas can escape to the atmosphere and contribute to climate change if not carefully contained.

### **Reducing atmospheric pollution**

SPX earned the 2007 Stratospheric Ozone Protection Award for developing the SPX Robinair 34788 refrigerant recovery and recharging unit. This product is the only equipment of its kind that meets new industry standards that require refrigerant recovery and recharging equipment to 1) recover at least 95 percent of the refrigerant from an automotive air conditioning system, and 2) recharge the system to within 1/2 ounce of refrigerant capacity. Previously, refrigerant recovery machines left behind as much as 30% of the refrigerant, which could then escape to the atmosphere.

### **Individual and team contributions**

The EPA also honored Gary Murray, manager of mechanical product engineering for SPX Service Solutions, with the 2007 Climate Protection Award for his work as a member of the Improved Mobile Air Conditioning Service Emissions Reduction Team. The team worked tirelessly on a research program to determine new methods for reducing refrigerant emissions. Gary provided critical assistance, utilizing the testing and engineering resources of SPX to expedite the development of the new design and validation of equipment to meet the new SAE (Society of Automotive Engineers) standard.

### **A cleaner, safer environment for the future**

“Every day our employees around the world work hard to develop new products and services that help our customers enhance the performance and productivity of their businesses, while also enabling them to run cleaner, more environmentally friendly operations,” said Chris Kearney, president and CEO, SPX Corporation.

“It is a tremendous honor to be recognized by the EPA for our active efforts to do our part in making the environment cleaner and safer for future generations.”

## INDUSTRY NEWS

### SULLAIR ANNOUNCES AVAILABILITY OF S-ENERGY™ SERIES COMPRESSORS



Michigan City, IN, April 2007 — Sullair Corporation, a business unit of Hamilton Sundstrand, a United Technologies Company, is pleased to announce the availability of its S-energy™ Series compressors. The S-energy™ Series has shown to be more energy efficient than compressors of similar design.

Considering that energy costs represent 76% of the total cost of owning a compressor, the savings achieved by the S-energy™ Series significantly reduce the total life cycle costs.

Contributing to the energy savings is the time-proven Sullair air-end design with integrated inlet valve. Savings are further maximized because the S-energy™ Series compressors come with low package pressure drop and optimal cooling system with energy-efficient low noise centrifugal cooling fan. Variable speed drive models are available that yield optimum energy savings and the additional dividends of operating consistency.

The S-energy™ Series compressors are available in either standard or encapsulated air-end models ranging from 15 to 60 horsepower with capacities of 43.7 to 267 acfm and pressures from 100 to 175 psig.

Sullair is one of the world's leading compressor manufacturers and is the only air compressor manufacturer to concentrate exclusively on rotary screw technology. Sullair has been an industry leader and innovator since 1965. With subsidiaries in France, China and Australia, Sullair is also a globally recognized manufacturer of compressed air contaminant removal equipment, vacuum systems, portable compressors and contractors' air tools.

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## STAINLESS STEEL FRL'S FROM PARKER HANNIFIN

### Ideal for Corrosive and Wash-Down Environments



RICHLAND, MICHIGAN, JUNE 15, 2007 — Parker Hannifin Corporation (NYSE: PH) offers a comprehensive line of pneumatic stainless steel filters, regulators and lubricators. The Parker Prep-Air® Stainless Steel Series of air preparation units is ideal for protecting pneumatic system components in corrosive and wash-down applications. All units meet NACE specifications.

Featuring 316 stainless steel construction, Parker Prep-Air II filters, regulators and lubricators are corrosion-resistant and suitable for wash-down duty in demanding environments such as food processing. Parker FRL air preparation units feature high flow rates, standard fluorocarbon seals and are suitable for systems with pressures up to 300 PSIG.

Prep-Air II air line filters are available in miniature (¼" port size) and standard (½" port size) models and feature a two-stage filtration system. Liquids and coarse particles are removed in the first stage, which ensures removal of smaller particles. Filter particulate ratings are 5 to 40 microns. A stainless steel T-handle version of the Prep-Air II filter is also available to eliminate the acetal bonnet on the standard units.

Coalescing filters, also available in miniature (¼" port size) and standard (½" port size) models, use a thick membrane of "borosilicate" glass fibers coated with epoxy to remove liquid aerosols (down to .01 microns) and sub-micron particulate matter (.3 micron). All filters in the Parker Prep-Air II product line are available with manual and automatic float drains. Filter kits and accessories are available as well.

Prep-Air II pneumatic regulators have a large diaphragm-to-valve area ratio for precise regulation and high flow capacity. Regulator adjustment mechanisms and springs are of 316 stainless steel construction, with fluorocarbon diaphragms and seals. Models are available with ¼" and ½" ports. Pressure adjustment ranges are available from 0–250 PSIG. Regulator kits and accessories are also available.

Parker Prep-Air II air line lubricators supply a controlled state of oil delivery to the pneumatic system; the oil delivery rate increases linearly with the increase of air flow. Standard port size is ½". Lubricator kits and accessories are available.

An array of port sizes, types, bowls, elements, material, pressure ranges and options are available when ordering Prep-Air filters, regulators and lubricators. For more information about Parker stainless steel FRLs, contact Parker Hannifin Corporation, Pneumatic Division. Phone 269-629-5000 or visit online at [www.parker.com/pneumatics](http://www.parker.com/pneumatics).

## INDUSTRY NEWS

### TENCARVA MACHINERY COMPANY ADVANCES IN 2007 'BIG 50' RANKINGS OF INDUSTRIAL DISTRIBUTION MAGAZINE



GREENSBORO, N.C., June 12, 2007 — Tencarva Machinery Company, a distributor of pumps, compressors and related accessories headquartered in Greensboro, N.C., moved up to 46th from 48th in the recent rankings by the national publication, *Industrial Distribution*, of its "Big 50" list of top U.S. headquartered distributors, based on sales and earnings.

Tencarva's 2006 sales increased to \$124 from \$105 million through the efforts of more than 250 employees in the 22 branch offices in the eight states where Tencarva operates.

Rod Lee, Tencarva's president, reports that 2006 was an excellent year for Tencarva, since the company's "base business grew significantly, excluding acquisitions." The acquisition of emoryWilson Co. expanded the company's presence in the municipal market, and Engineering Equipment Co. added product lines. The company's compressed air business is growing, and the phosphate industry, a major source of business in Florida, is recovering from a lean period.

Though many of the "Big 50" companies were challenged in the area of finding and retaining qualified employees, Lee indicates in the publication that Tencarva has the advantage of being 100 percent employee owned. "The stockholders are the employees, and they have the same opportunities as management. . . .That remains our best retention tool."

Ed Pearce, Tencarva controller, points out, "We are very pleased with our performance in 2006. Our 2007 year is shaping up to be very good as the industrial sector continues to be strong, and we will have a full year of revenue from our two 2006 acquisitions."

Tencarva Machinery Company is a distributor specializing in liquid process, compressed air, vacuum equipment and custom-designed systems for the industrial and municipal marketplace. Tencarva is dedicated to providing the highest quality process machinery, coupled with superior customer service and integrity.

Founded in 1978, Tencarva Machinery is committed to providing superior service by supplying innovative engineering assistance, professional equipment selection, competitive deliveries and parts availability, and preventive maintenance and repair services to all its customers. Tencarva has 22 branches in eight states, including Arkansas, Florida, Maryland, Mississippi, North Carolina, South Carolina, Tennessee and Virginia.

For additional details on Tencarva, contact Ed Pearce, controller, at Tencarva Machinery Company, 1115 Pleasant Ridge Road, Greensboro, NC 27409-9753, (336) 665-1435. For information on Tencarva, please visit the website at <http://www.tencarva.com>.



Ed Pearce



Rod Lee

# ADVANCED SOLUTIONS FOR YOUR COMPRESSED AIR CHALLENGES



The BEKO range of reliable performance products includes all aspects of economical, safe and ecologically responsible compressed air use. With their unique and diverse capabilities, all of the product families meet the demands of tomorrow's advancements today, from individual components right up to those of complete large-scale systems.

Being that every system, no matter how large or small, is made up of individual components, only components that are designed to work with each other, and are suited to rigorous applications and conditions can fulfill their performance expectations in a reliable and environmentally friendly way.

BEKO does more than manufacture phenomenal products, we are a complete solutions provider. Ranging from analysis of the problem, to specification, installation support, maintenance resolutions and comprehensive customer service, the BEKO know-how for compressed air use is customer oriented with a global focus.

## CONDENSATE KILLS

### BEKOMAT® 31 AND 32



Maintenance time is now 2-minutes or less

Aluminum housing construction

Zero air loss

**BEKO** quality and reliability

### THE NEW ÖWAMAT®



Cartridge based system - Quick and clean

Increased performance

No activated carbon

Separates condensate emulsions and mixtures

Each drop of condensate in the compressed air system involves risks, and these risks can kill cost accounting and profitability at any time. Superior condensate management can only be achieved through the use of reliable and technologically advanced products like those offered by **BEKO** Technologies. With over one million installations of **BEKOMAT**® condensate drains, the numbers simply speak for themselves. **ÖWAMAT**® oil-water separators set the industrial standard for condensate treatment.



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

We didn't start engineering the world's most energy-efficient compressors when it became the "in" thing to do. And now – when it matters more than ever – our eight decades of design innovation and fine-tuning translate into systems that are up to 25% more energy-efficient than the competition.

That adds up to a lot of valuable energy ... and bottom-line dollar savings, too. Enough, in fact, to pay for your compressed air equipment many times over.

With age comes experience. So, when you're comparing compressor performance and reliability, it pays to remember the lengths we've gone to ... for generations.



**KAESER**  
**COMPRESSORS**

*Built for a lifetime.™*

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Certified Management System

