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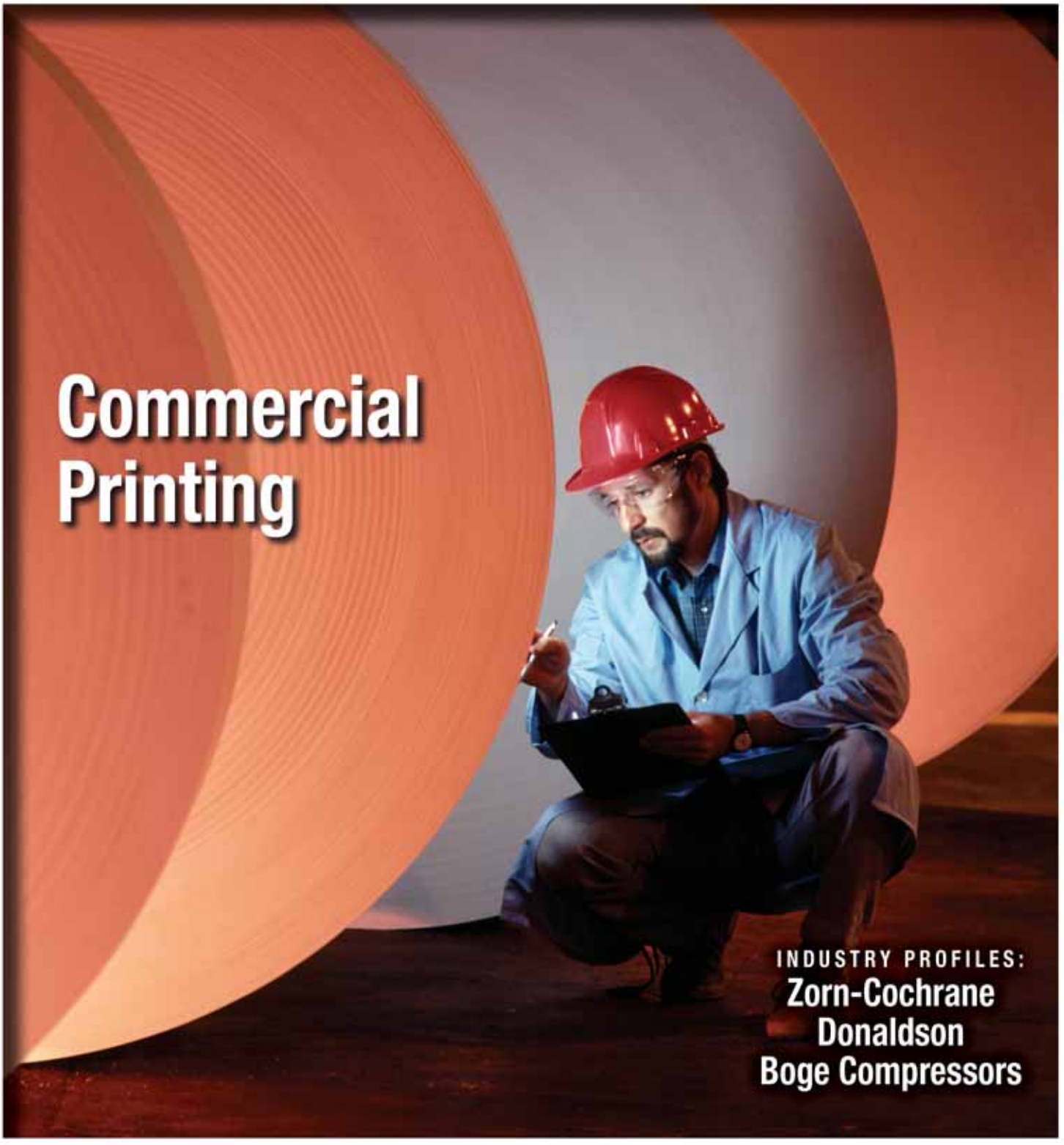

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FROM THE EDITOR

Compressed Air Makes Pneumatic Automation Possible

After working in the compressed air industry for a number of years, it is easy to start taking for granted what compressed air accomplishes. Known to some as the "Fourth Utility", compressed air is present in most manufacturing facilities-for many good reasons. One reason is that it makes pneumatic automation possible. Printing presses, for example, will not function without compressed air (both high and low pressure). The engineering behind using compressed air, to automate the printing process, is remarkable. While our industry, appropriately, is very focused on managing the energy costs associated with producing compressed air, plant engineers and production workers realize the benefits of pneumatic automation on a daily basis.

Increased productivity and labor savings are two obvious benefits of pneumatic automation. One operator can perform more than one task, when automation is present. Automation can also make an operation more efficient and increase output (normally exponentially). Automation often performs tasks, which are very repetitive. A pneumatic turntable, in the bindery of a commercial printer, makes the stacking process more efficient. When this was done manually, worker fatigue and boredom could result, while doing this for eight hours. The same worker is now released to perform more highly skilled functions.

Quality and safety are also enhanced through automation. Automation often results in greater consistency and repeatability in a production process. A properly designed pneumatic automation device, with proper air support, will perform the same every time. Hazardous environments are also ideal for pneumatic automation. Fewer work-related injuries and insurance claims represent benefits to all involved.

Automating is required to survive in manufacturing today. Innovative new ways to automate processes, using pneumatics, are constantly being created. Compressed air system specialists and pneumatic automation designers are working closely together. Heidelberg printing presses, for example, have a completely integrated compressed air supply system.

Unifying the understanding of the supply and demand sides of a compressed air system brings many benefits. As we manage the compressed air system, let's remember the fundamental benefits of reliable pneumatic automation.

ROD SMITH

ASK the EXPERTS

This area is designed for readers of Compressed Air Best Practices Magazine who have questions regarding their compressed air systems. The editors of this magazine invite readers to email us questions and issues they may have. We will forward the questions to experts in compressed air systems, with whom we work, and provide answers to 100% of the questions. We will choose a few questions, each month, and print them in the magazine so that others may learn from the process.

Please note that answers provided are done so with limited information. Answers should be considered guidelines to consider. In no way, do the writers or this magazine assume responsibility for any actions taken as a result of these answers. Questions may be sent to rod@airbestpractices.com

Question #1 from Hammond, Indiana

I had been told that by replacing or changing all air compressor motors to variable speed drive (VSD), I will lower my electrical energy costs. I have three 100 horsepower rotary screws and run all three. Should I replace all these with variable speed drive as has been suggested?

> "With amperage, voltage and power factors, you can calculate kW."

This question cannot be answered accurately without more data about your load profile. To say that just installing new VSD drives or VSD compressors will lower your bill is inaccurate. We recommend that no major action or monies be invested on new equipment or piping without a review of the plant air load and system dynamics. VSD's can be a great solution or can actually make a system worse depending upon the situation. Below are some things to consider:

- A VSD is much more efficient, as a trim unit, than a similar size constant-speed version at loads from 25% to 75%.
- A variable displacement constant-speed compressor, of similar size, is more efficient than a VSD from roughly 75% load to 100% load.
- A VSD, when applied at full load, will draw more power, for the same flow, than a similar size constant-speed compressor. This can be 4–6% more in lubricated rotary screws and up to 13% more in oil-free designs.

The key to the correct application of an appropriate trim compressor is to identify the load profile for each work shift (including weekends and holidays). This will allow you to estimate how many hours the trim unit will be working and at what load.

Question #2 from Dubuque, Iowa

Can I calculate the air flow from my compressor by measuring the amperage and the discharge pressure?

The only time this works is when tracking full-load and no-load amperage on a two-step controlled unit. With this we can calculate the percentage at full-load and the percentage at no-load, to come up with an average load. If you know the input power, compressor type, type of unloading control, motor data….etc., you can come pretty close in estimating flow by measuring input power.

Keep in mind that amperage is not a true reflection of power — kW is a power measurement. With amperage, voltage and power factors, you can calculate kW. If you measure these three variables (which is required) with a hand-held motor analyzer, you will get kW and can calculate probable motor efficiency (ME).

Please note that power measurement, in any form, is not a good estimating tool for centrifugal compressors — except to indicate whether the unit is in turn-down or not. To accurately estimate the flow without a flow meter, you need the original performance curve, if available, along with the inlet and discharge pressures and inlet temperatures. Even with a flow meter, we usually estimate as close as possible in order to double-check.

Question #3 from Milford, MA

Is it true that inlet guide-vanes on a centrifugal compressor will increase the amount of "turn-down"?

Inlet guide-vanes (IGV), used instead of an inlet butterfly valve (IBV) will not increase the amount of turndown. They will improve specific power (efficiency or scfm/kW) of the compressor throughout the turndown range. Many people, including the writer, believe the IGV allows much smoother turndown enabling and encouraging the operator to set the controls to full effective turndown. For best performance, controls should be reset seasonably, unless you are running a control system that calculates inlet conditions and changes in its program and automatically readjusts itself.

ASK THE EXPERTS

"How can I tell how much air I am losing, so I can see if a new compressor is required?"

Question #4 from Tulsa, OK

My 350 horsepower XLE has come loose on the foundation. We have installed new hold-down bolts and clamps, but they don't hold. What should we do?

Without seeing the installation, it is hard to give an exact recommendation — but here are some key thoughts:

- The only way to reset the unit, on the foundation, is to move the compressor, clean the old grout off the foundation, reinstall new grout and then the unit. This can't be done if the foundation is crumbling, cracked and/or soaked with oil. If any of this exists:
  - The foundation will have to be removed down to solid, clean, concrete and then rebuilt back up before regrouting.
  - Another option is to cut the foundation down to floor level and install a proper "inertia base" instead of a new foundation. Professionals should be called in to review this option.
- Be sure you are not in inlet or discharge-piping "critical length" (to avoid). This data is available in the instruction manual. If you don't have it, air system professionals can calculate "critical length" if given information on the compressor (model, bore, stroke, and rpm).

Question #5 from Canton, OH

We are looking at a replacement compressor for our 1989, 100 horsepower, lubricated, rotary-screw air compressor. It runs well and our maintenance people like it. It is now almost 17 years old and has never been over-hauled. The salesman from a major manufacturer of rotary-screw compressors told me that as old as this unit is, it has probably lost a great deal of capacity — due to wear between the rotors. Is this true? How can I tell how much air I am losing, so I can see if a new compressor is required?

Lubricated rotary-screw compressors (all brands) do not lose capacity due to normal running wear. The sealing points are at the "rotor tips to cylinder" and the "rotor tip to the bottom flute" between the rotors. The male rotor is usually the "driving rotor" carrying about 90% of the power load. The female rotor is the driven rotor and runs like an "idler". The rotors drive through a "pitchline contact point" below the crown or edge on each rotor. This point gets very little significant wear over time, ina high-quality rotary-screw. Any wear which does occur (more like polishing) is not at a sealing point — there is so significant effect on performance.

There may be other reasons why you should consider a different-type air compressor. "Loss of capacity" due to wear, however, should not be one of the reasons.

Answers provided by Hank Van Ormer. Mr. Van Ormer is a leading compressed air systems consultant who has implemented over 1200 air improvement projects. He can be contacted at (740) 862-4112, email: hankvanormer@aol.com, and www.airpowerusainc.com

BANTA PUBLISHING & INGERSOLL RAND

Compressed Air Best Practices interviewed Dan Tatman, (Plant Engineer/Maintenance Manager) of Banta Publishing and Bill Beckman (Senior Systems Engineer) of the Ingersoll Rand Company

COMPRESSED AIR BEST PRACTICES: Please describe your operations here.

DAN: Our facility, here in Greenfield, Ohio, employs 250 people and is a special-interest magazine printer. Our customers have very targeted audiences and have weekly, monthly, biannual and annual publications. We are a "short-run" facility with average print runs of 25,000 impressions. Banta Publications Greenfield is part of the Banta Publishing and Catalog Solutions Group of Banta Corporation. Revenues for the printing service segment were $1.12 billion in 2005.

When did you two start working together?

DAN: I had worked with Ingersoll Rand equipment, during all of my 24 years in the automotive industry, before coming to Banta Greenfield in 1998. I had always found IR equipment to be very reliable and asked Bill to come in when I saw the situation here in Greenfield. Banta had just purchased this facility and I was being paged two to three times daily with serious compressed air related problems.

BILL: Together with Dan we reviewed a lot of problem areas in the air system, which are not uncommon in manufacturing environments.

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The facility had grown over the years and had added air compressors over the years. Dan is a rather unusual customer in that he has an in-depth understanding of compressed air systems. We worked together and did a comprehensive system analysis. Some of our findings included:

- The piping system had four entry points, from the four tank-mounted rotary screw air compressors (from another manufacturer). There were many dead-heads and low pressure areas in the piping system.
- The air compressors were on the production floor, creating a lot of heat right next to the production workers. Each 50 horsepower air compressor was generating 150,000 btu's of heat per hour and creating an uncomfortable work environment plus creating extra work and expense for the HVAC system.
- Printing press problems caused by low air pressures
- Work stoppages caused by air compressor system shutdowns

How did you come to gain such in-depth knowledge in air systems?

DAN: Managing our compressed air system is an important part of my job. It has been important to have a partner like Ingersoll Rand to provide counseling and training on compressed air systems. Compressed air plays a vital role in the success of a commercial printing facility. As we saw in 1998, a poorly managed system can have a significantly adverse effect on production levels and cost structures. Today, after having implemented a very efficient and reliable system, our energy costs associated with compressed air are $98,000 per year or 15% of our total energy bill. A facility which is not managing this utility closely can see that balloon to 30-35% PLUS see major incremental production costs related to a poorly designed compressed air system.

Where is compressed air used in a commercial printing facility like Banta?

A commercial printing facility uses "high pressure" air (we are at 90 psig) and low pressure air (5-10 psig). I'll walk you through the applications for "high pressure" air. A printing facility like ours, normally has two major production areas using compressed air; the press line area and the bindery.

Banta Greenfield has four Harris M300 web printing presses. Maximum speed is 1200 feet of paper per minute. Maximum print width is 36 inches. They are dual-web presses, which can run two rolls of paper at the same time. A closed-loop color system automatically controls the color. We also have a half-web cover-press for a total of five printing presses. A press line (or printing press) is actually made up of several diiferent machines arranged in modules. A press line is made up of a splicer, infeed, print units, dryer/ovens, chill stand, web guides, silicon applicator, and a folder or a sheeter (folds and cuts) and or sheeter (just cuts).

Please describe the roll splicer and the infeed.

A paper roll splicer allows you to splice one roll of paper to another roll of paper without ever stopping the press. This, of course, eliminates down-time for the press associated with changing paper. The roll splicer has many pneumatic actuators, brakes and valves moving air cylinders which assist with the application of the two-sided tape which splices the two webs together. A "web", by the way, is what we call the paper in a printing press.

The infeed maintains tension on the web going through the units. The paper going through can stretch and move around if not controlled. The infeed is set to maintain a certain level of tension on the web. At Banta we maintain 80 to 200 pounds of tension, depending upon the job. Air cylinders along with a harmonic drive are what maintain the web tension. This is an example of why stable air pressure is so critical. If air pressure drops, the infeed will not be able to maintain the tension on the web and the paper will start to move around in the press.

Harris M300 Web Printing Press at Banta Greenfield

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How is air used in the print unit?

Compressed air powers the pneumatic cylinders, which move the impression cylinders in the print unit. The impression cylinders must be applied, on and off to the web, at a specific pressure. We maintain the air at a minimum pressure of 90 psig.

Air is also used to help control the registration (print alignment) from one unit to another. A printing press uses four basic colors. When printing an image, the press lays one color on top of another to create the desired color. The alignment is critical to achieve high-quality color. Air nozzles placed in between the printing units, known as air bustles, blow air up onto the web to help maintain the alignment or registration. We use vortex nozzles because they minimize air useage. We use regulators to regulate the flow and solenoid valves, which assure that the nozzles only blow when the print unit is up to speed.

How about the rest of the modules in a press line?

"Maximum speed is 1200 feet of paper per minute. Maximum print width is 36 inches."

The dryers/ovens have some air cylinders used to actuate door cylinders and an air table. The oven removes solvents from the ink but the ink remains tacky. To dry the ink, the web moves into the next module, called the chill stand. Cooling, using chilled water, sets the ink. The web has to stay tight against the chill roll in order for cooling to occur. Compressed air cylinders provide pressure for the nip rollers (rubber rollers) which keep the web tight up against the chill roll.

The web guides are electrical and the silicon applicator uses no air. The final module in a printing press is the folder/sheeter. A folder simply folds the 8 or 16 or 32-page spread while a sheeter folds and cuts the sheets. Air cylinders are used in these modules.

So now the printed, folded, and cut paper can go to the bindery?!

That is correct. In the bindery, we have two different ways to assemble and bind a magazine together. Both processes use compressed air. We have stitchers, which use two or three staples, to bind a magazine together. Perfect binders are the second option, which will glue the pages together to the spine. Thinner magazines are normally stitched while thicker magazines are perfect bound. At Banta Greenfield, we use Muller Martini stitchers and Heidelberg perfect binding machinery.

Both stitchers and binders have carousels with different modules. The conveyor gathers the pages in the proper order from pocket feeders, and sends it forward for stapling/binding. Compressed air is used to maintain tension on the gathering chain of the conveyor. After stapling/binding, the magazine then travels to the trimmer, where excess paper is cut off. Three sides of the book get trimmed to put it to proper size. We use compressed air for "blow-offs" to blow the trim to an extraction chute. Here again, we use solenoid valves to make sure air only blows when the trimmer is working.

Heidelberg UB1 Perfect Binder at Banta Greenfield

How about the stacker and the Arpac?

After the trimmer, we apply mailing labels at the mail table. Once the labels are applied, the magazines are now ready to be stacked and packaged in bundles of 3 to 20 pieces. Magazines, when stacked, cannot have all the bindings on the same side. They must be compensated so that the stack balances out. We use a pneumatic rotary table to compensate the stack. Pneumatic cylinders rotate the table to accomplish this.

A heat-shrink tunnel, called an Arpac, represents the final step in the bindery. Pneumatic cylinders move the heat shrink-wrap carriage, which wraps plastic around the stacks of magazines. Unless customers make special bindery requests involving polybags or cover inserts, the magazines are now ready for mailing.

Stable air pressure sounds critical.

Absolutely. We have listed many examples of where stable pressure is essential. Constant and adequate air pressure and flow is critical for the impression cylinders in the printing press. If air pressure goes below 90 psig, we see a bounce effect, which causes a skip in the printing. The upper and lower impression cylinders must have sufficient air pressure or we cannot maintain print quality. This causes a press line stoppage until air pressure is restored.

What effect does air quality have on printing production?

Water in a compressed air system is catastrophic. We have open blowing applications in many areas where air comes into direct contact with the magazines we print. If any water was present, the magazines would come out with water spots and would not be accepted by our customers. Water will also cause the many solenoid valves and spool valves in pneumatic

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Refrigerated Dryer and Oil Mist Eliminator at Banta Greenfield

control circuits to stick and rust over time. Repairing these damaged valves causes down-time on the press line. Water will also create rust in the piping system if it is made of black iron.

Oil and solid particulate filtration is also critical. Oil in the air, in the open blowing applications, will result in shiny oil spots on the magazines. Black iron pipe will rust if water is present. This creates pipe scale which can block orifices and valves in pneumatic circuits.

Please describe your compressed air system today?

We have not had a work stoppage, related to compressed air in over six years. The equipment has been very reliable and our associated energy costs are where they should be — although we will never stop working on those costs.

We scrapped the old system entirely and in two phases, in 1999 and again in 2001, we put together a completely new system following Bill's recommendations:

1. Established a separate air compressor room with good ventilation. The room is on the shady-side of the facility and we rarely see ambient temperatures inside the compressor room above 95˚ F in summer. We exhaust the heat outside in the summer and recover the heat, if needed, during the winter.

2. Purchased three Ingersoll Rand air-cooled, direct-drive, EP-150 rotary screw air compressors. They are capable of 670 scfm each at 125 psig. We normally run 1½ air compressors and have the third as a redundant compressor.

3. Do quarterly service on the machines. Assures timeliness of service and provides an extended 5 year warranty and an extra discount on parts. We use IR ultracoolant, which is biodegradable, and extends the warranty. We also do vibration analysis.

4. Control the air compressors with a Intellysis Energy Optimizer (IEO) which allows us to override the local controls, which can have a 10 psig pressure band. This takes the overall pressure band down to 2-3 psig. We can program how we want to run every day. We are assured 90 psig on the floor with a pressure setting of 100 psig.

5. Trained the maintenance guys on the controls and put visual and written instructions on the air compressors. Labels with directional arrows are also prevalent on the compressed air piping.

6. Installed a direct digital control (DDC) system plant-wide. We can monitor and control HVAC, chillers, vacuum, low pressure pumps and air compressor system in my office or even from home. I can call up all kinds of data, system air loop pressure, amps on each air compressor, outlet air temperature,….etc.

Banta Greenfield Compressor Room

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7. Our air quality requirement is a +35 F dew point, 0.5 ppm oil removal and 1 micron particulate filtration. To accomplish this we installed a particulate filter, thermal mass refrigerated dryers, and NL module mist eliminators.

8. We installed a continuous loop piping system around the plant for compressed air. Each air compressor has a 400 gallon wet storage tank in front of it. The air then goes into the air treatment equipment. We have block and bypass 3-valve systems which allow us to route the air wherever we want. There is a single point of entry from the compressor room to the air loop.

9. We do monthly leak-detection projects looking for low-hanging fruit. We pick a weekend and go up and down the line listening for obvious air leaks.

10. We haven't had the system down in the six years which have passed since we made the changes.

What are some of your future plans?

As part of a corporate-wide program to save energy, we are planning to install a 3600 gallon storage tank with a Intelliflow Demand Expander. This will lower the pressure in the air loop by isolating changes in air demand from the air compressors. We will also put a variable frequency drive (VFD) motor on one of the EP-150's to accomplish. Since we are a short-run printing facility, with big swings in load, we are perfect for VFD's. With these modifications, we should see an approximate 25% ($25,000) reduction in the energy costs associated with producing compressed air.

Thank you and congratulations on your "Best Practices" commercial printing operation.

For more information please contact: Dan Tatman, Banta Publications, Tel: 937-981-6333, email: DTatman@banta.com or Bill Beckman, Ingersoll Rand, Tel: 1-800-631-6014, email: Bill_Beckman@irco.com

BEST PRACTICES IN COMMERCIAL PRINTING

BY BOB LAINE

The printing industry is a huge industry with many different types of printing processes. The printing industry produces newspapers, books, monthly bills, direct mail, magazines, instruction manuals, to name a few. This article will focus on the larger portion of the industry, which is newspaper and book commercial printing. Both use considerable quantities of compressed air.

The modern printing press is a piece of production equipment that will include paper supply from large rolls of paper. The paper is placed on the press to unroll in a horizontal plane, where the movement and articulation of the roll is frequently accomplished using compressed air driven cylinders and conveyors. The printing press uses many rolls, which are not used at the same time and whose movement and positioning is controlled by compressed air cylinders. Compressed air is used to transfer the paper sheet between press sections and the final product is packaged. Paper dust is also a significant environmental issue where compressed air is used to clean reverse-pulse bag houses or cartridge filters.

Compressed Air Supply Systems

Supply of compressed air varies from lubricated screws for most of the smaller systems (less than 2,000 scfm) to oil-free centrifugals or large dry screws for larger systems (greater than 5,000 to 6,000 scfm). Most systems will have some contamination in the form of water and/or oil even though there is clean up equipment consisting of dryers and filters. System pressure requirement will be at or above 100 psig, but the article pressure or actual use pressures will typically be less than 80 psig.

Contamination is a major issue in almost all printing environments. Compressed air frequently comes into direct contact with the paper where water and oil will destroy the final product. Open blowing of compressed air is used to separate sheets, control the flow of sheets, transfer from one press to another, sheet insertion, and sometimes equipment cooling (hot bearing for example). Any contamination will, at a very minimum, create a housekeeping issue. Water or oil on the printed sheet creates a loss of product that has no recovery value and must be disposed of in an environmentally safe fashion, which also has a cost.

Most equipment manufacturers (printing presses) expect to install their equipment in a system with as least some contamination. This forces them to install point of use clean-up and control equipment (filters, regulators & lubricators) which increases capital costs. Additionally, the differential pressure of these components increases operating cost in the form of a higher supply pressure required to overcome the pressure drop of these point-of -use components. Since the printing press manufacturer is not responsible for operating costs (higher supply pressure), there is seldom any engineering of the point of use components. Capital cost is the primary criteria in the selection of these items. The least expensive components will more than likely have significantly greater differentials. Some applications such as air bearings cannot tolerate any contamination. This will result in extra filtration and drying equipment at the point of use.

Most supply systems will have (at least limited) clean-up equipment consisting of a refrigerant dryer and filtration. A few will use the more expensive desiccant dryer technology. The “system” for printing applications needs to be free of all liquids absolute for all operating conditions, which can be accomplished with refrigerant or desiccant technologies. One must understand all of the limitations of every piece of equipment that makes up the system and live within those limitations and the system will be contamination free. Compressed air supply from the compressor room that is clean and dry, will not require point-of-use filters or additional dryers. This can reduce capital costs, filter maintenance costs, and pressure drop.

Open Blowing In Printing

Open blowing is a major constituent of demand in most printing operations. Open blowing using high pressure air (100-psi) is very expensive compared to low pressure blowing, where the supply is from a dedicated system using a low-pressure blower at 5 to 6-psig. Open blowing is a mass flow application where pounds of air at a velocity are used to perform work. The pressure just upstream of the open blowing nozzle, regardless of the supply source, will be near atmospheric or nowhere near the 100 psig of the high -pressure system. If the air is to be used at less than 10 psig, why compress it to 100 psig? A 10 psig low-pressure blower will make considerably more air, per brake horsepower, than the typical industrial air compressor. This makes using low-pressure, as the supply source for open blowing, a good business decision. Most industrial compressors make slightly more than 4 scfm, per brake horsepower, where a low-pressure or positive displacement blower will make more than 11 scfm per brake horsepower.

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A considerable portion of high-pressure, open-blowing nozzles, use crimped-copper tubing, which is terribly inefficient at shaping the air stream to perform work. Low–pressure, engineered, nozzles can shape the air stream to fit the application by applying the work force where needed. The final result is the exact same mass flow (pounds of air at a velocity) as with high pressure air, for less than half to one fifth the operating cost, with a more efficient delivery, which actually improves the work performed.

Additionally, low-pressure blowing does not require clean-up equipment (filters and dryers) because we are compressing the air to less than one atmosphere and the blower is oil-free. We do have the low-pressure blower to maintain, but maintenance here will be insignificant compared to that of a compressed air system.

Rate of Flow vs Average Flow

Point-of-use components have an impact on the performance of all equipment in the facility, including diaphragm pumps, air motors, vibrators, dust collectors, and cylinders. For the most part, cylinders do not use any significant quantities of compressed air unless there are leaks from worn seals or solenoid control valves. A 4" diameter by 10" long cylinder, a good-size cylinder in the printing industry, will have an internal volume of 125.6 cubic inches or 0.0726 cubic feet, which does not include the volume of the cylinder rod, which is 0.00681 cubic feet. This cylinder will consume 0.473 cubic feet of air at 80 psig when extending the cylinder. This is not a lot of air, even if it actuates 10 times per minute for a total demand of 4.73 scfm. This volume can be supplied by a ¼" OD tube. The problem is that the cylinder will actuate in a half second where the critical issue is the rate of flow, not the average flow. To calculate the rate of flow, we must add time to the equation, which is the actual flow times 60 seconds per minute divided by the actuation time. This would be 0.473 scf multiplied by 60, divided by .5 seconds actuation time to equal 56.76 scfm rate of flow. This is considerably larger than the 4.73-scfm actually used by the cylinder. All of the point of use components (filters, regulators, lubricators, fittings and piping) must be engineered using the rate of flow calculation, not the actual flow. This is one of the main reasons that cylinders are sluggish or do not actuate smoothly. It is a very common practice of manufacturers to install a reducing bushing in the cylinder ports. For example, the 4" cylinder in our calculation above will normally have a ¾" tapped port that will be reduced to ¼" supply tubing, which reduces the manufacturer's cost. ¼" or even ⅜" tubing cannot supply > 56-scfm rate of flow without a huge differential. This one cylinder installation (¼" supply tubing) will likely increase the supply pressure requirement 10 to 15 psig to overcome the lack of engineering at the point of use. There is no cost to the printing press manufacturer if the commercial printer has to increase the supply pressure to solve a sticky cylinder.

Every printing facility has some kind of packaging equipment or palletizer. Packaging equipment does not use great quantities of air, but it needs to be clean and dry and at a constant pressure (± < 1.0-psi) to achieve consistent repeatable results. Rate of flow and storage have to be applied to maximize system performance — where one of the most important issues is timing. A single cylinder that is sticky or hesitant, requiring a longer actuation cycle, will destroy the timing of the entire palletizer. This does not mean that every cylinder in the facility must be re-piped to solve this problem. Properly applied dedicated storage will frequently solve the sticky cylinder problem, which usually is considerably more attractive from a cost perspective.

Compressed Air Leaks

Leaks in the printing industry are usually a significant demand constituent. Control of the equipment is mostly pneumatic or electro-pneumatic and there is a significant amount of small diameter plastic tubing and push-on or push-loc type fittings. The number of places where leaks can occur is large and the quick disconnect/connect design of fittings, frequently leak after reassembly. As a result there is the general assumption that leak repair offers a considerable opportunity to reduce demand. This is usually not the case.

It is impossible to fix all the leaks and new ones will continually be an issue. Repair of leaks will usually result in an increase of system pressure. This increase in pressure will increase the demand of all the leaks that were not repaired and also the demand of all unregulated applications. Therefore, the savings from leak repair does not exist in most instances. Some will argue that the compressor controls will see the increase in system pressure and reduce supply, which should reduce operating cost. But the reality is that the compressor controls will usually not respond to a system pressure change of less than a couple pounds. Unregulated applications and the remaining leaks will. The higher pressure will also likely start new leaks. Therefore, repair of leaks that requires labor and materials (cost), frequently results in no reductions in operating cost or savings.

There can be exceptions to every issue with compressed air. If the plant does not have enough air to operate because of leaks, leak repair is a good business decision compared to purchasing an additional compressor. In a system that has positive pressure control in addition to compressor controls, leak repair can result in an attractive return of investment, but pressure control must be properly applied first.

Bob Laine is an independent auditor of compressed air and vacuum systems with more than 10 years experience in many different industries. Mr. Laine is President of Compressed Air Auditing (compressedairauditing.com). Contact information is (706) 288-8900 or email: bobbysc@aol.com

COMPANY PROFILE

Q&A ZORN-COCHRANE: INVESTING IN CUSTOMERS

Compressed Air Best Practices interviewed John Zorn, (President), Matt Zorn (Vice President-General Manager), and Dave Wick (Vice President-Operations) of Zorn-Cochrane Compressor & Equipment Inc.

COMPRESSED AIR BEST PRACTICES: You have a very large company in Wisconsin. We'd like to review all the investments you have made.

We have been working hard here in Wisconsin on compressed air systems since 1965. We believe we have learned a few things along the way. The company was started with a single location in Milwaukee, in 1965, as Cochrane Compressor Co., Inc. Today, Zorn-Cochrane is headquartered in Pewaukee and has 60 employees with full-service branch facilities in Green Bay, Wausau, Madison and Eau Claire.

CABP: With all due respect, isn't that a big investment for the size of the Wisconsin compressed air market?

Factories that use compressed air in Wisconsin require and deserve this type of investment. It is often difficult for them to know what kind of company they are dealing with when it comes to compressed air. Compressed air plays a critical role in their production processes and carries with it significant energy costs. We see huge differences in the capabilities of air compressor distributorships in their abilities to meet the compressed air needs of industry in Wisconsin. Many factories

Zorn-Cochrane Headquarters in Pewaukee, Wisconsin

settle in with their service provider and are too tolerant (or unaware) of mistakes being made or of unreasonably high energy-costs associated with their compressed air system. This is why we have made the investments in technical service, inventory, auditing, company infrastructure, and supplier relations.

CABP: What is the size of your field service group?

We have 18 dedicated and highly-trained, air compressor Field Service Technicians in the state of Wisconsin. They have an average of ten years working experience and are factory-trained on a regular basis. Zorn-Cochrane invests in factory training so we keep up with the latest technologies. The Company has this large field service group because we believe it is critical to have them within a one hour drive to the majority of our customers on a 24/7 basis. This investment in proximity provides our customers with a rapid-response guarantee.

The technicians are not only experts in air compressors. They are also certified refrigeration technicians. This means that the same person that works on the air compressor can work on the refrigerated air dryer sitting right next to it. This is another service benefit for our customers. Many air compressor distributors call in a refrigeration contractor to work on air dryers. While they understand refrigeration, they do not understand the whole air system. Our technicians have the advantage of knowing what the air compressor is doing and how it is affecting the refrigerated air dryer, and all other components of the entire system.

> "Hospitals, automotive aftermarket, printing, and dairies are just a few of the many markets we serve."

It is also important to provide field service technicians with the proper equipment. End users should be sure that their service providers carry the appropriate equipment. Our technicians are provided with a truck fully stocked with parts, hand tools, and the instrumentation devices required to measure voltage, amperage, pressure, vacuum, refrigeration charges, pressures, and temperature guns for coolers to name a few.

CABP: What does a "full-service" branch location mean?

All of our branches are what we call a "full-service" branch. "Full-service" starts with a staff of experienced local service technicians. They are supported by inside parts personnel and supervised by a service manager. Inventory of parts and rental equipment to meet the customer base is essential. Sales Engineers with application experience complete the branch staffing.

A Full-Service Branch For Air Compressor Repair

ZORN-COCHRANE

Company Profile

Each branch facility is equipped with overhead hoists, repair benches, cleaning equipment, and enough power to fully test the machines they sell, up to 500 HP. Repair capabilities include cooling systems, drive components, controls, compression elements and electrical systems.

This is designed to offer our customers the products, service, and attention they deserve.

Bar-coded Parts Inventory

CABP: Describe the investment made in inventory.

A high percentage of our service work is done as part of a scheduled service agreement. This allows Zorn-Cochrane to customize the parts inventory to our customer base and ensure that parts are always in stock. We are one of a few compressor distributorships, in the U.S., that does bar-coding on our parts inventory. This helps us increase our turns, improve our efficiency and accuracy, and better service the customer.

CABP: Please describe the role of your Sales Engineers

The Zorn-Cochrane sales staff acts as consultants to our customers. They help customers with their processes. With an average of ten years experience, they are all trained to help customers understand the demand and supply sides of a compressed air system. Most are located within a one-hour drive of their customers which again reflects our investment in proximity to our customers. They are all capable of doing the measurement processes required to analyze a system. Data logging, analyzing, and writing reports for customers are a standard part of the job.

CABP: When are audits necessary?

Every situation is unique and our Sales Engineers make the determination of what is required. When a factory would like to have their compressed air system analyzed, we have three levels of analysis we can offer.

1. The Air Insight Program does data-logging monitoring pressure and amperage. We take the collected data, download it into a Zorn-Cochrane proprietary program, look at controls and type of compressors, and get a base line of what is happening. We will then supply the customer with a report.

2. We are factory-trained to implement a Quincy Compressor Efficiency Quotient (EQ) Audit. This process, which won an award from Frost & Sullivan in 2006 for Customer Service, takes data inputs and generates high-quality reports on the compressed air system.

3. The final level is to conduct a full-fledged audit. We personally inspect every aspect of the air system, and provide a comprehensive baseline analysis. We then provide recommendations with project pay-back figures.

CABP: What investments have been made into the computer systems at Zorn-Cochrane?

After more than thirty years of active participation in various distributor associations, we have learned the importance and need of investing in management systems. Computer systems have received major investments at Zorn-Cochrane. Today we have two systems, one for sales and service, and one for inventory and accounting. We have also invested in custom programming to allow these systems to share useful data (talk to each other), thereby integrating the two systems. All sales engineers and service technicians input customer and call information into the system daily and it all goes to the same database. All branches are on the same system. We invested, and continue to do so, in the training component of the system as well. The resulting data we collect allows us to do mailing programs, target marketing, and simply manage our business in an agile manner.

CABP: Please describe financial and legal management challenges.

Financial and legal sophistication is critical. We focus on maintaining a strong relationship with our bankers and making sure the needs of both parties are met. Understanding how to finance things and when is critical. Managing lines of credit and using them for appropriate expenses is an example. Legal issues can also arise. For example, many customers have indemnification clauses which must be thoroughly read and reviewed. It is important to know when to walk away. It is also important to be able to provide a customer with an alternative indemnity clause, which is agreeable to both sides.

ZORN-COCHRANE

Company Profile

CABP: How do you manage the cyclical nature of capital equipment business?

We manage and greatly reduce our exposure by diversifying the markets we serve and by being heavily invested in both sales and service. We are active in a broad variety of markets in Wisconsin. Hospitals, automotive aftermarket, printing, and dairies are just a few of the many markets we serve. This diversity provides some protection against trends in specific industries. When the economy is strong, our investments in sales allow us to benefit from an increase in capital equipment projects. When the economy is soft, the strong service organization normally sees more repair work. We find the result to be a quite steady business model.

CABP: In the supplier-distributor relationships, what is the role of the distributor?

We see our role being to provide comprehensive service to our assigned market. It is our role to present the best product, system, and solution to meet the customers' needs. In order to do this, to best serve our customers, we offer a broad range of product lines. We must also give our suppliers market feedback to help them be close to the needs and trends in

COMPRESSED AIR CHECK-LIST

Zorn-Cochrane President, John Zorn

The printing industry is a significant user of compressed air and vacuum systems. Zorn-Cochrane has extensive experience working with printing companies and with OEM's of printing presses. Printers use a mixture of air compressors, blowers, and vacuum systems to get the job done. Printing facilities have one thing in common — they operate under unforgiving timelines. A newspaper, for example, has to go out on time. This creates a demand for reliable compressed air systems. If the air system is down, so are the printing presses. When this occurs, rapid solutions must be found.

Common Problems

Paper dust can create a dusty and dirty environment in a printing facility. While many facilities have made great advances, dusty ambient air entering the intake of the air compressor provide strong particulate filtration challenges which may result in pressure drops in the compressed air filters.

The urgency to get back on-line can also lead to the misuse of high-pressure air. Low-pressure blowers are used on printing presses to fluff the paper so it doesn't stick together when drying. This also removes static from the paper so it doesn't stick together. If a blower goes down, the fastest way to keep running can be to hook-up to the compressed air system. This is a common band-aide solution, which has high associated energy-costs versus the use of a blower. Repairing the blower might then be forgotten and this blowing application is left to the compressed air system.

Systems may be fragmented between spot-location vacuum pumps and centralized vacuum and/or low-pressure blowers. Many big printers use centralized systems, due to higher efficiencies and less maintenance, while smaller companies use spot-location systems. The mid-size printers, as they grow, face a decision on what to do. We recommend, at a certain size, to go to a centralized system. We always, however, recommend you keep the spot-location vacuum pumps in place as back-ups in case the centralized system goes down.

The Compressed Air Check-List

A plant engineer at a printing facility should ask his/her compressed air specialist to provide answers to the following questions on the demand and supply side of the compressed air system. The result should be the creation of performance metrics and goals for the compressed air system, which will lead to an optimal system.

Understand What Is Creating Demand for Compressed Air

- ❑ 1. How many air leaks are there and what is it costing the company?
- ❑ 2. Is the compressed air distribution system (piping) a loop system (this is recommended) or does it have dead-ends which create pressure drops and low-pressure areas. What is this costing the company?
- ❑ 3. What machines do we have which need compressed air? Make a list of all the printing presses, binders, folders, gluers and check the need for compressed air.

the market. The responsibility as a business partner is something we take seriously. Doing the basics: paying on-time, providing good representation with intelligence and integrity, applying products intelligently, and communicating with the factory are critical.

CABP: What is the role of your suppliers?

To provide the appropriate support and training to meet the market demands for lead times, quality, competitive prices and customer service. Another role is to keep ahead or at least to stay with the trends of new product development. Innovation is a critical role for our suppliers.

CABP: What are the market trends in compressed air?

The market is going to smaller and quieter air compressors with smaller footprints. Auditing, air assessments, and consultative selling are also here to stay. We have also seen a movement from reciprocating to rotary air compressors due to sound attenuation. We plan to continue making the required investments in these and other areas.

CABP: Thank you Zorn-Cochrane for your insights.

For more information please contact Matt Zorn, Zorn-Cochrane Compressor & Equipment Inc., Tel: 262-695-7000, email: matt.zorn@zorn-air.com, web site: www.zorn-air.com

FOR PRINTING INDUSTRY

❑ 4. How much air do these machines need and at what pressure? What is the cost?

❑ 5. How much air and at what pressure are we supplying air? What is the cost?

How is Compressed Air Supplied?

❑ 1. Do a condition assessment of the air compressors. Are they operating up to capacity? Make sure this is done with amperage draws and measurements. Do an evaluation to see if the air compressors are unloading and loading properly and are producing up to their "design capacity".

❑ 2. Examine the air treatment equipment. What air dryers and filters exist in the system? How dry is the air in terms of dew point and are particulates and oils filtered out of the system. What is the pressure drop being created to treat the air and how much does this cost?

❑ 3. Is there enough compressed air primary storage capacity in the compressor room?

❑ 4. Review power supply. Is there enough power? What are our expansion capabilities and do they match our requirements if we need to add equipment?

❑ 5. How are the air compressors controlled? Should a sequencer be used?

Establish Metrics and Goals

❑ 1. What is our total electrical cost, related to compressed air, over a twelve-month period? How many tons of paper (establish a output metric) has our printing facility printed for this electrical cost associated with compressed air?

❑ 2. What is our optimum ratio of electrical cost vs output?

❑ 3. Finally, what is the cost to the company if the air system goes down?

Questions to Ask Your Compressed Air Specialist Before Beginning

❑ 1. What process will be used to answer the above questions

❑ 2. What will you charge to spend the time to answer these questions

❑ 3. What are your qualifications to answer these questions

❑ 4. If our air system went down, what rental air compressors or vacuum pumps could you bring in and how quickly could you do it?

For more information please contact Matt Zorn, Zorn-Cochrane Compressor & Equipment Inc., Tel: 262-695-7000, email: matt.zorn@zorn-air.com, web site: www.zorn-air.com

Refrigerated Air Dryer with R-134a Refrigerant

DONALDSON

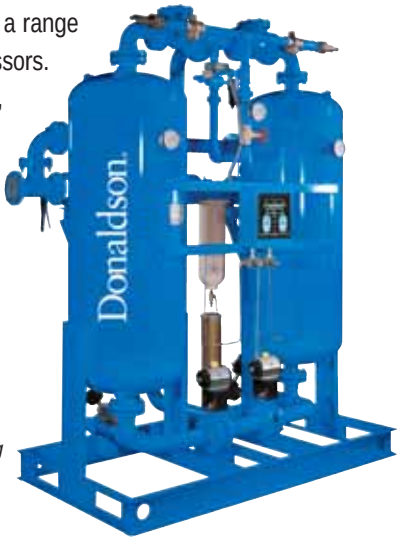
Based in Minneapolis, Minnesota, Donaldson is a 91 year-old manufacturer of filtration systems and replacement filters. The company has more than 450 active U.S. patents, operates in 35 countries, employs more than 11,000 people, and posted revenues of $1.6 billion in 2005.There are two major business groups at Donaldson, the Engine Systems & Parts Group and the Commercial & Industrial Group.

COMPRESSED AIR BEST PRACTICES: Where does Compressed Air & Gas fit with in Donaldson?

The Compressed Air and Gas (CAG) group falls into Donaldson's Commercial & Industrial group of businesses, which also includes Donaldson Torit in-plant air filtration and hydraulic filtration. While Donaldson has been in the compressed air & gas market for several decades, it plans to increase its focus on this market in 2007.

CABP: What investments have been made in the Compressed Air and Gas Division?

Donaldson began an aggressive acquisition strategy in 1999 when it purchased AirMaze. This provided the company with a range of air intake filters and air-oil separators for air compressors. In 2002, Donaldson acquired ultrafilter international AG, a large compressed air dryer and filter manufacturer based in Germany, giving the company a strong presence in Western Europe. The recent acquisition of AirCel Corp., a U.S. compressed air dryer manufacturer, has given us manufacturing capability in the U.S. Now, we are positioned to become truly global in the CAG market.



Heatless Pressure-Swing Desiccant Air Dryer

COMPANY PROFILE

A NEW, GLOBAL EMPHASIS BY THE MARKET LEADER IN FILTRATION SOLUTIONS

Interview with Donaldson Compressed Air & Gas

CABP: What is your strategy?

Donaldson strives to be the leader in all of the markets in which it participates. Our CAG market strategy is consistent with that philosophy. Because we have sought to develop a well-diversified, global revenue stream, our efforts in CAG also have been focused on developing a global manufacturing and production platform in filtration and dehydration equipment for compressed air systems. We truly offer one-stop shopping to our business channel partners and end users by offering on-compressor and "downstream" products. The on-compressor products are the intake filters and air/oil separators found in an air compressor. They perform the critical functions of removing contaminants from ambient air, before compression, and of removing oil from the compressed air before it is sent downstream. The downstream products are the compressed air filters and dryers located right after the air compressor or at point-of-use locations on the factory floor.

Our worldwide effort allows us to diversify the geographic markets we serve and to provide local markets with the products they want. The AirCel acquisition gives us local manufacturing and engineering capabilities. We can now quote U.S.-built "specials" such as 50,000 scfm refrigerated and desiccant air dryers, 10,000 psig high-pr ers, heat-of-compre dryers, and natural gas dryers.

CABP: What is your branding strategy with all these acquisitions?

Donaldson is a strong industrial brand name. Donaldson is the company brand and the companies we acquire become product line brands. We have executed this branding strategy successfully many times. In CAG, we offer Donaldson Ultrafilter products and Donaldson AirCel products, capturing the brand equity present in both names.

CABP: How will the AirCel acquisition be integrated into Donaldson?

AirCel will be integrated in two major phases. The first phase involves product line and system process integration. Clemens Heinrici, Product Director, is working with the engineering teams in the U.S. and Europe to take the best of the AirCel and Ultrafilter product lines and to decide which best serve the local geographic markets. Meanwhile, Tina Pocrnich, Program Manager, has the full-time responsibility to smoothly integrate functions and systems into Donaldson, such as human resources, payroll, and invoicing.

Phase two involves integrating more complex processes such as material planning in operations. Donaldson has a wealth of manufacturing experience, much of which is being extended to the AirCel facility in Maryville, Tennessee to help them prepare for the forecasted increases in volume.

CABP: Will there be global products?

Yes, when it makes sense. We will use core technologies that can be packaged in every continent. Heat exchangers, for example, may be chosen as a core technology for refrigerated dryers, which can then be packaged in every continent with locally accepted electrical components.

CABP: What is the manufacturing and customer service strategy for North America?

Products will be manufactured wherever they can best meet the needs of the local market. The AirCel factory in Tennessee has tremendous capabilities for engineered "specials." Our applications engineering team in Maryville has more than 100 years of experience to offer our customers.

Fast deliveries for standard products are provided ex-works, from our Rensselaer, Indiana, national distribution center. We have just expanded

DONALDSON

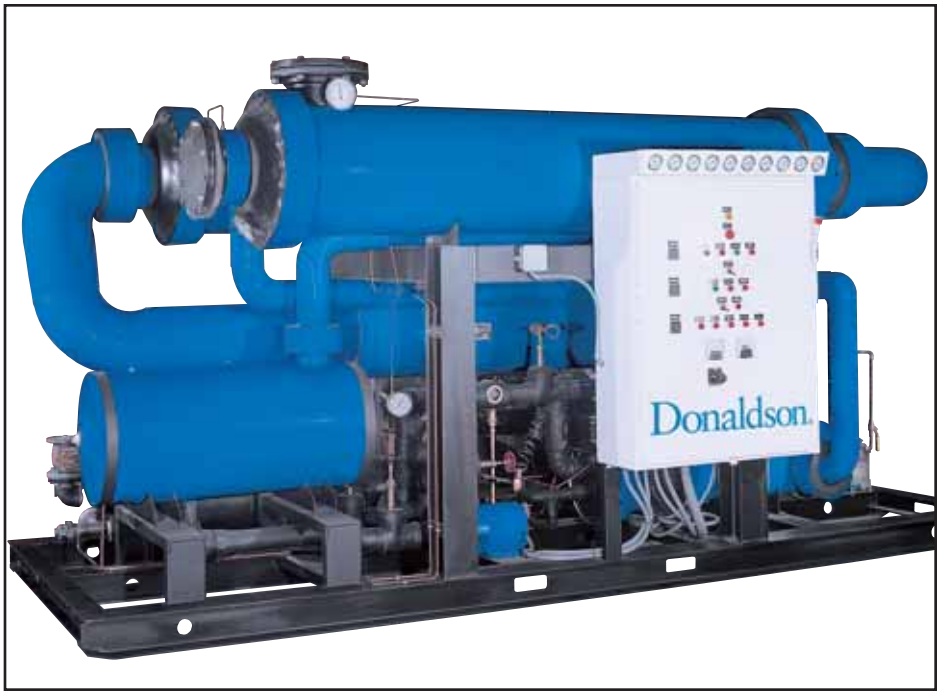
Company Profile

the center by 215,000 square feet — it now covers 610,000 square feet and has 102 loading docks!

CABP: What does this mean to a Donaldson Compressed Air & Gas Distributor?

We have taken the best of Donaldson Ultrafilter and AirCel and now offer new programs including:

- On-line order tracking
- Info-Center: Secured extranet site where product info is available
- Automated Quoting Tool: size and price models automatically
- Automated on-line sales lead program
- Dryers now have 2-year warranties
- Refrigerated dryers use the environmentally-friendly refrigerant, R-134a



Cycling High-Capacity Refrigerated Air Dryer

CABP: What are the trends in technologies in the market and at Donaldson?

Donaldson has always focused on developing technologies that add value, and in compressed air preparation and gas drying, we have the same focus. While we manufacture both cycling and non-cycling refrigerated dryers, we see a trend toward energy-saving "cycling" refrigerated dryers with lower product lifetime costs. Non-cycling dryers are becoming a "base-level" dryer for customers more interested in initial price.

We also see greater knowledge of condensate management in the U.S. Compressed air dryers and filters separate significant volumes of water and oil from the compressed air stream. End users are becoming more aware of the need to separate the oil from the water and to dispose of it responsibly.

CABP: What is next for Donaldson?

Our engineers are busy working on new technologies and programs. Marketing is creating consolidated price books and literature. Our district sales managers are busy working with the Donaldson Compressed Air & Gas Distributors, training them on our technologies and products.

CABP: Thank you Donaldson.

For more information please contact: Darin Ficenec, General Manager CAG, Donaldson Company, Phone: 952-887-3109, email ficenec@Mail.Donaldson.com or visit www.donaldson.com

Boge Manufacturing Center in Germany

COMPANY PROFILE

BOGE COMPRESSORS

Compressed Air Best Practices interviewed Tim Tarrant, (CEO and President) of Boge Americas Inc.

BOGE COMPRESSORS

Company Profile

Rotary Screw Production Line in Bielefeld

COMPRESSED AIR BEST PRACTICES: May we be the first to congratulate BOGE on it's 100-year anniversary (even if we are five months early)?

Sure! In a few months, Boge will begin it's centennial year. We have many celebrations planned around the world to commemorate one hundred years of Boge (the kick-off to the celebrations will occur during the 2007 Hanover Fair April 17-21). Boge was created in Germany, in 1907, by Mr. Otto Boge. The company began the business by manufacturing a line of hydraulic door closers. A visionary and a entrepeneur, Mr. Boge led the company into manufacturing motorcycles in the 1920's. These motorcycles gained notoriety with their performance in distance races. The company moved into air compressors, in the late 1920's, manufacturing piston air compressors for gas stations. Tires had just gone from hard rubber to air-inflated tubes and gasoline stations were the primary market for air compressors.

As industrial applications for compressed air drove demand for piston air compressors higher, Boge built a new facility in the early 1950's to support this demand. The company got involved with rotary screw air compressors in the 1970's and kept expanding. The company relocated, in 1984, into the plant we are in today which covers 180,000 square feet in Bielefeld, Germany. Bielefeld is a city of 300,000 people, located 3 hours northwest of Frankfurt. Our company today has 550 employees worldwide.

What international presence does the company have?

The company has always had a large export market for it's products. In the early 1990's, the company began an international expansion with subsidiaries around the world. This included the entry into the United States in 1999. We also opened our first manufacturing facility, outside of Germany, in China in 2003. This facility has done very well and is focused on manufacturing oil-free and oil-flooded rotary screw air compressors. All models are 100 horsepower and larger and are sold exclusively in China. The international expansion has been very successful for Boge. We sell six times more rotary screw air compressors today than we did in 1990.

Boge Americas Headquarters

Please describe your operations in the U.S.

Boge has been growing in North America since we entered in 1999. We recently moved into a new facility, in the Atlanta area, which increased the size of our facility by 33%. We stock a complete line of oil-flooded rotary screw air compressors from 4 to 200 horsepower. We also stock

all the required spare parts for all the machines. The facility has a test lab where the air compressors are put through a test before they are sent to the field. We also stock a full range of variable speed compressors and a complete line of clean, air treatment equipment. Our equipment is all U.L. approved and we have appropriate certificates for most provinces in Canada. We have modified the equipment so that the inlet/outlet connections are NPT and/or use flanges. The programmable logic controllers have also been converted into the appropriate units of measurement for this market, such as psig and scfm.

Boge Rotary Screw Air End

Where are the trends heading for air compressors?

Smaller rotary screw air compressors will continue to gain popularity. Boge just finished installing a $2 million manufacturing cell to support this business. The new cell has equipment for stator cutting and machining for our 4, 5, and 7.5 horsepower models in Bielefeld. These encapsulated-type units are unique in that they provide a super-quiet 64 dba sound level-without a cabinet enclosure. Boge designed a special sound-attenuating coating for the airend housing, which makes a cabinet unnecessary. This new CL Series product line, which also has wye-delta starters and TEFC motors, is a very popular machine.

Variable frequency drives (VFD's) are also the thing of the future — if not of the present. Our models provide energy savings of 15% when loads range between 30–80%. Other benefits are the lower amperage draws on start-ups and the reduced wear and tear on major components of the compressor. This is also a popular product line for us.

What makes a BOGE air compressor different?

We believe that ease of maintenance is our #1 virtue. We use spin-on oil-separator filters on all models, for example. This is made possible by our horizontal sump tank. The longer length of the tank, sitting horizontally, provides more space for oil separation. This also reduces the amount of foam in the oil because of the horizontal tank, with the air end setting on top of it. This allows for less foam in the oil which allows Boge to successfully use spin-on separators filters– rather than bulky and expensive mechanical separators in pressure vessels.

BOGE COMPRESSORS

Company Profile

Boge Rotary Screw Air Compressors

Boge has also been able to standardize on some key features, which end users like, in order to make them affordable. All rotary screw air compressors, 10 horsepower and above, have standard full enclosures with a 40 micron cabinet prefilter. Motors have TEFC as standard as well as Wye-Delta starters. This standardization has proved effective when contrasted with manufacturers who use the "menu" approach and charge extras for all of the above "options". Making it standard drove our costs down and we did not need to pass the costs on to our customers for these added features.

Thank you Boge Compressors.

For more information contact Tim Tarrant, CEO, Boge Americas, Tel: 770-874-1570, email: t.tarrant@boge.com, or visit www.boge.com

INDUSTRY NEWS

Press Releases

NEW SCROLLSTAR® PROVIDES BLAST AIR

Heidelberg Presses Feature Integrated Compressor

Heidelberg ScrollStar® systems supply all the blast air needed at the printing press. ScrollStar® supplies compressed air that is completely free of oil and condensation to the press. The units are accommodated in cabinets to effectively eliminate noise, reliably filter intake air, and efficiently remove waste heat. Heidelberg is the only press manufacturer that has developed its own air supply cabinets.

The Scrollstar® uses an Atlas Copco SF4 scroll air compressor to provide oil free, dry air for all pneumatic systems in Heidelberg Speedmaster presses. The scroll compressor provides a quiet, nearly maintenance free source of compressed air. An integrated dryer uses a refrigeration system to extract the moisture from the air; then re-warms the air to prevent the potential for condensation in the press. Scrollstar® is powered directly by the press' electrical distribution and is fully integrated into the pneumatic system and electrical controls of the printing press.

There are 3 versions of Scrollstar® available for Heidelberg presses. The 3 versions are as follows:

1. Scrollstar® — consists of an Atlas Copco SF4 compressor modified and specially configured for Heidelberg sheet-fed presses.

2. Scrollstar® Plus — consists of the same modified Atlas Copco SF4 compressor mounted in a cabinet. The upper section of the cabinet contains an additional blast-air blower, that is speed controlled, to provide a blanket of air over the delivery-sheet guide plate. The Scrollstar® Plus is used exclusively on SM102 and CD102 presses built after Drupa 2000 with a Preset Delivery.

3. Scrollstar® Plus 2 — consists of the same modified Atlas Copco SF4 compressor mounted in a cabinet. The upper section of the cabinet contains 6 additional reservoir tanks for added capacity during high demand situations. This compressor configuration is standard for special presses where the potential exists for high air demand during specific operations.

Heidelberg Scrollstar®

For more information contact Amanda Sullivan, Manning Selvage & Lee, Tel: 404-870-6853, email: Amanda.sullivan@mslpr.com

INDUSTRY NEWS

Press Releases

KNOW PRESSURE
COMPRESSED AIR CHALLENGE™

CAC™ "BEST PRACTICES MANUAL"

The Essential, Product-Neutral Reference for End Users of Compressed Air Systems

The Compressed Air Challenge™ (CAC) *Best Practices for Compressed Air Systems* manual is considered the essential, product neutral educational guide for compressed air systems. With thousands of copies sold since 2003, and an updated edition coming soon, we thought a look at this important tool would be of interest to our readers.

The *Best Practices for Compressed Air Systems* manual — or the Best Practices Manual — is comprised of more than 300 pages of original text and reference appendices, photos and performance data, for use to help compressed air end users and service providers to improve operating efficiencies and reliability of installed compressed air systems. The CAC created the Best Practices Manual to provide end users with the tools to reduce the operating costs associated with the use of compressed air and improve the reliability of the entire system. It includes information to implement recommendations, which will:

1. Reduce energy and repair costs
2. Improve system reliability
3. Increase productivity
4. Reduce unscheduled downtime

The manual begins with considerations for analyzing existing systems or designing systems, and continues through the compressor supply to the auxiliary equipment and distribution system to end uses. The reader can determine how to use measurements to audit their system, calculate the cost of compressed air, and even interpret utility electric bills. Best practice recommendations for selection, installation, maintenance and operation of all the equipment and components within the compressed air system are in bold font and are easily selected from each section.

According to the CAC's David Terry, companies and other organizations that are interested in arranging a special edition printing of the manual with reference to their firm on the cover should contact the CAC before the next printing. The new edition of *Best Practices for Compressed Air Systems* will be released in the fall of 2006.

For more information about CAC or the Best Practices Manual, please visit www.compressedairchallenge.org or contact David Terry (dterry@statelineenergy.org) or Aimee McKane (ATMcKane@lbl.gov).

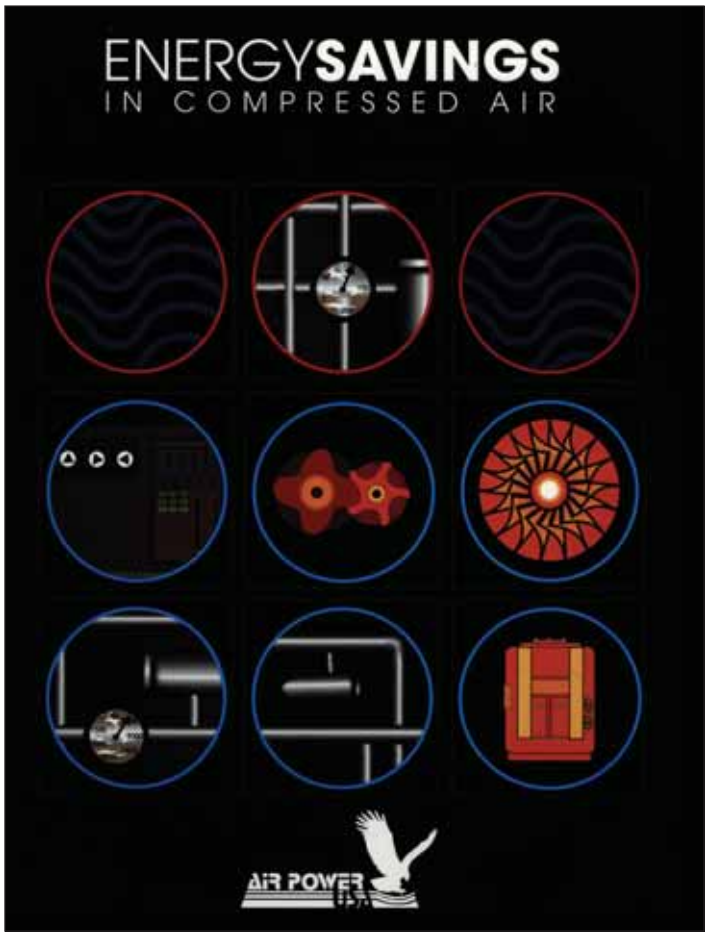
EDUCATIONAL RESOURCE ON COMPRESSED AIR

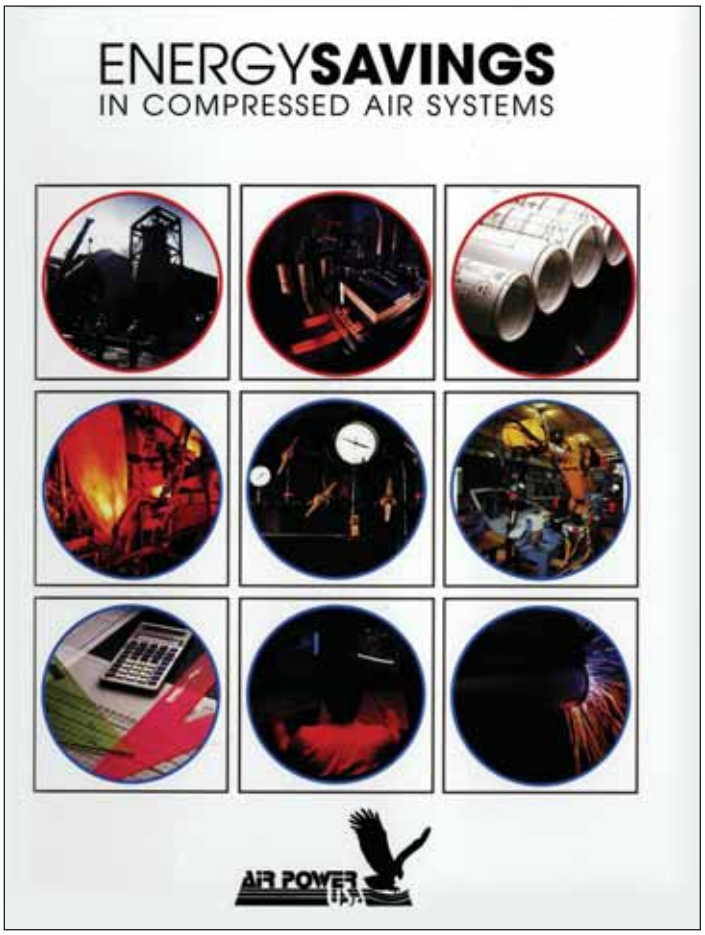
Air Power USA Publishes Two Books

The book, Energy Savings in Compressed Air, is a practical guide to compressed air systems and accessories including: centralized versus decentralized systems, basic piping, air compressor types, applications, selection, and installation, compressor capacity, controls, and operating costs, accessories (dryers, synthetic lubricants, receivers, filters, traps, electronic regulation), predictive maintenance, condensate removal, and EPA issues. The book costs $85.00 and was published in 2005.

The book, Energy Savings in Compressed Air Systems, is the next logical step in helping you control your compressed air system by eliminating demand on the compressed air equipment. It helps you understand the cost of operating process equipment such as: point-of-use filtration, regulation, lubrication, distribution piping, and point-of-use storage to cover a demand event. It covers demand side issues for heat recovery, compressed air savings opportunities, i.e., open blows, diaphragm pumps, quick disconnects. This book also describes how ultrasonic leak detectors work, how to utilize them and how to measure flow to different sectors of your plant. The book costs $85.00 and was published in 2006.

For more information contact Hank Van Ormer. Mr. Van Ormer is a leading compressed air systems consultant who has implemented over 1200 air improvement projects. He can be contacted at (740) 862-4112, email: hankvanormer@aol.com, and www.airpowerusainc.com





INDUSTRY NEWS

Press Releases

CAGI OFFERS E-LEARNING COURSEWARE ON KEY ASPECTS OF COMPRESSED AIR SYSTEMS

Cleveland, OH, May 2006 — Unique E-learning courseware, titled *Introduction to Compressed Air Systems*, is now available to the industrial community from the Compressed Air and Gas Institute (CAGI), the leading organization representing manufacturers of compressed air system equipment. The courseware provides training on important aspects of compressed air systems and is designed to help users obtain maximum air system efficiency.

Consisting of seven modules, *Introduction to Compressed Air Systems* begins with compressed air basics, then focuses on types of compressors, capacity controls and distribution systems. The final three modules complete the courseware, concentrating on controlling wastes, air treatment and compressor installation and air system maintenance.

Offered on SmartSite (www.cagi.org/smartsite/public.asp), CAGI's innovative online center for learning and technical information, the courseware is available 24/7 and allows participants to learn at their own pace at home or in the office, saving both time and money.

Registration enables continued access to the courseware for a full year so that refresher sessions can be planned and complex scenarios can be addressed. In addition, the courses can be used as continued education units (CEUs) where required for employment or career advancement.

Other tools and learning aids available through CAGI's SmartSite include technical papers, videos, CDs, an educational poster and CAGI's widely used Compressed Air and Gas Handbook.

For more information, please visit www.cagi.org, or contact John Addington, Compressed Air and Gas Institute, 1300 Sumner Avenue, Cleveland, OH 44115-2851; Tel: (216) 241-7333; Fax: (216) 241-0105; e-mail: cagi@cagi.org.

READER SERVICE INQUIRIES: *Please direct inquiries to John Addington, Compressed Air and Gas Institute, 1300 Sumner Avenue, Cleveland, OH 44115-2851; e-mail: cagi@cagi.org.*

EDITORS NOTE: *Since 1915, the Compressed Air and Gas Institute (CAGI) has been the leading organization representing the compressed air industry. Through education, training and the development of industry standards, the Institute helps improve the production, proper use and increased distribution of equipment used in compressed air and gas systems. By encouraging collaboration among member companies, which include manufacturers of compressors, blowers, pneumatic tools and air and gas drying and filtration equipment, CAGI consistently increases the standards of excellence in the compressed air industry.*

MOVE it FOR LESS

Low Pressure and Low Vacuum Equal Low Cost

BY DAN BOTT

Open blowing of compressed air can be one of the most wasteful applications in a printing facility. Compressed air is used to assist movement of product along production lines and to keep paper within the confines of production equipment. The upside to this handy tool is ease of installation and the ability to fit small compressed air nozzles in hard to reach locations. The downside is the significant and mostly unrealized cost of using plant air for this task. Most people are generally

Elmo Rietschle Zephyr Claw Pump

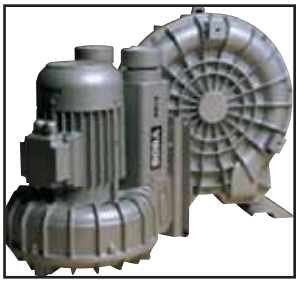
MOVE IT FOR LESS

Low Pressure and Low Vacuum Equal Low Cost

aware that there is a higher cost associated with using compressed air in this manner, but it is apparent that few are aware of how high that cost really is. Making a technology change from compressed air nozzles to low pressure, blower/air knife systems, for the motive air supply mechanism, can make a huge difference in the financial bottom line.

Open blowing applications come in many forms. From simple ⅛" diameter copper tubing, bent to the direction of production machine flow, to elaborately configured compressed air "trees" that perform multiple functions. One of the most wasteful is the ¾" diameter pipe drilled with a dozen holes and placed over a paper application. It is not uncommon for these devices to use over 100 scfm of compressed air flow and be online whether the production machine is operating or not! It is also common to see compressed air nozzles blowing into the open air — nowhere near the intended location and performing no useful function. There can be 1,500 scfm, or more, in open blowing applications in any moderately sized printing facility. Performing a pneumatic systems audit or compressed air systems audit, provides an opportunity to evaluate all types and configurations of these applications. Findings from an audit will typically reveal that there are better and more cost effective methods of doing these jobs. When the cost analysis is complete, rarely is there a question about the efficacy of making a change.

The first step in the evaluation process is to determine the cost of generating, drying, cleaning, and distributing plant air at pressures of 90 to 125 PSIG. This is an important step in that typical site compressed air headers operate at supply pressures of 100 PSIG, for example, and the typical open blowing application utilizes plant air at pressures less than 2 PSIG. A convenient way to compare efficiencies is an analysis done in SCFM output (standard cubic feet per minute) from the compressed air system per input energy in kilowatts (KW). Typical compressed air systems provide efficiencies in the range of 4 SCFM per KW to 5.5 SCFM per KW with an average of 4.75 SCFM per KW. This takes into account factors such as part loading of compressors, the cost of drying the air, inefficiencies in the distribution system and other non-optimal issues in any supply system. Of course there are some systems with higher efficiency and many systems with lower efficiencies but this is a good representation of what may be found in the printing industry.



The second step is to determine the efficiency of low pressure, high volume blower/air knife systems that can be used to replace compressed air nozzles in open blowing applications. Low-pressure blowers are available in several different technologies and many configurations. Examples of industry offerings are rotary lobe, regenerative, centrifugal, vortex, side channel and many others. These blowers are typically operated at pressures of no more than 1 PSIG to 5 PSIG but can attain higher pressures depending upon the design configuration. They also provide for very high airflow rates. For example, a typical side channel blower for a point of use application will develop 1.4 PSIG and deliver 30 SCFM of air with only 0.3 KW of input energy required. This equates to an efficiency of about 100 SCFM per KW. Compare this to the compressed air system efficiency of about 5 SCFM per KW and it is easy to see how to save money by modifying these applications. Table 1 shows how much cost can be eliminated, by replacing compressed air devices, with a low-pressure blower/air knife systems.

COST COMPARISON: OPEN BLOWING VS. LOW PRESSURE BLOWERS

AIR FLOW IN SCFM	COMPRESSED AIR ANNUAL ELECTRIC COST	LOW PRESSURE BLOWER ANNUAL ELECTRIC COST	ANNUAL SAVINGS
50	$4,611	$219	**$4,392**
100	$9,221	$438	**$8,783**
150	$13,832	$657	**$13,175**
200	$18,442	$876	**$17,566**
300	$27,663	$1,314	**$26,349**
500	$46,105	$2,190	**$43,915**
750	$69,158	$3,285	**$65,873**

Note: 8,760 hours/year and $0.05/KWH

Note that this is a general comparison to illustrate the magnitude of the cost difference between these two approaches. The reality is that there may or may not be a 1:1 replacement ratio between compressed air SCFM and low pressure blower SCFM. In other words, an application may require higher airflow with a low pressure blower system than with the original configuration. Nonetheless, the savings are significant enough to warrant an immediate evaluation.

There are several additional cost savings that can be realized. If enough compressed air demand can be shed from the system, it is likely that compressors and dryers can be shut down and placed in standby. Maintenance costs will be lower, there will be less demand on cooling air/water systems and high cost compressed supply equipment will have longer service life. There may also be a cost avoidance if new compressors do not have to be purchased. Note that point of use blowers are designed as dry compression technologies and require very little maintenance. Generally, the only maintenance items are inlet filter elements.

Determining the potential savings at a facility will first require that the total compressed air demand from open blowing be determined. One easy way to do this is to measure a representative number of open blowing applications with a simple, inexpensive in-line flow meter and extrapolate the total demand requirement. Take care to measure each application type and ensure that the supply pressures are similar. Higher pressures will of course result in higher airflow rates. Once the total demand is known, determine if a compressor can be taken off-line or if the system can be operated in a more efficient manner so that the savings can be attained.

Replacement of compressed air nozzles with low pressure blower/air knife systems will require flexibility in the philosophy of how the job gets done. There will be visible changes on production machinery and the task area will not look or be the same as it was. With either method, the goal is the same. Provide production with the most reliable and effective tool to enhance throughput. If the job can be completed effectively and reliably either way, there is good reason to choose the most cost effective solution.

MOVE IT FOR LESS

Low Pressure and Low Vacuum Equal Low Cost

There are several issues to consider regarding changes in technologies. The first is the fact that the blower will have to be mounted in close proximity to the point of use. Blowers are typically small enough to be mounted on production machinery but if space limitations exist, there will be a necessity to use precious floor space for the blower. The second issue is sound. Smaller blowers generate only 50 to 70 dBa but larger units can be significantly higher. Sound enclosures may be necessary for large blowers in environments where there is close proximity to production personnel. Finally, electrical service must be provided for blower operation. The costs for modifying electrical service should be included in the project ROI if adequate local service is not available.

> "Open blowing of compressed air can be one of the most wasteful applications in a printing facility."

If open blowing applications cannot be retrofitted with blower/ air knife systems there is an alternative. In those applications that are not suitable for blower systems it is recommended that engineered compressed air nozzles be utilized. These nozzles reduce air consumption by using an ambient air assist. For example, instead of a specific nozzle consuming 20 SCFM of compressed air, it is designed to use only 5 SCFM of compressed air and will pull in enough ambient air to achieve the same velocity and force as the original nozzle. They provide for an excellent alternative and still achieve the goal of reducing compressed air consumption.

There are also opportunities to save money by changing technologies in vacuum supply systems. Vacuum pumps are used widely in the printing industry and this provides an excellent opportunity to save on energy costs. Utilizing a vacuum technology that can attain high vacuum for low vacuum service is similar to using high pressure compressed air nozzles where low pressure blower/air knife systems can be used. A common practice is to pull high vacuum in a central header and then regulate down to the required vacuum level at the point of use.

What makes a vacuum system analysis a bit more difficult is that vacuum is utilized in many different printing and paper applications at every level of vacuum. In addition, while there are excellent choices for equipment, not all vacuum technologies are created equal — meaning technologies that can attain similar vacuum levels do not require the same power input. In some technologies, power input increases or decreases as vacuum level increases or decreases. In addition, when compressed air generated venturi vacuum pumps are thrown into the mix, the confusion becomes enormous.

Sorting out these factors can be cumbersome but some general guidelines can be illustrated. In typical installations, efficiencies of "high" vacuum pumps range from 18 to almost 30 ACFM per KW input. ACFM or actual cubic feet per minute is the volume flow to the inlet of the vacuum pump as opposed to the mass flow at the discharge of the vacuum pump. Low vacuum blowers can attain efficiencies of 60 to 200 ACFM per KW input. In many cases, changing technologies to low vacuum blowers will save at least 50% of the power input. This is quite remarkable considering there are additional maintenance savings and an elimination of issues around cooling water and lubrication.

A real life example of this is a site that was using six 50 horsepower reciprocating vacuum pumps in a system supplying vacuum at 23" HgV to a central header. The system was set up with a main distribution header and several sub headers with drop legs to production equipment. After measuring vacuum at the point of use it was found that 50% of the production machinery required vacuum at only 2" HgV to 4" HgV. While this may seem like an extreme example, the reality is that many systems are operating under these conditions. The solution in this example is to separate the low vacuum production machines and utilize a vacuum blower. Making this change will save over $40,000 in electrical and maintenance costs per year.

Whether it is compressed air or vacuum, it is critical to choose and utilize the correct technology for each production application. The stakes are high and competitive pressures are forcing manufacturing operations to eliminate waste and operate at the highest level of efficiency. It is quite probable that most of the low hanging fruit for cost savings have already been picked so it is time to go higher and harvest the remaining items. Evaluate the pneumatic supply arrangement at each production machine to ensure optimal service and lowest cost performance. The benefits are higher profits and better reliability.

For more information please contact Dan Bott, Dan Bott Consulting, Tel: (251) 960-1026, email: dan@dbott.com, or visit www.danbottconsulting.com

TROUBLE-SHOOTING

Part I

BY R. SCOT FOSS

I always do the following first when I walk into a facility that is new to me. I am trying to get a thousand foot view of the system. It is temping to dive right into the customer's symptom or the equipment. My experience tells me that I will probably miss the problem if I do this. I have advised technicians, over the years, to "push away" if you want to find the root cause of the problem.

When I first walk into a compressor room, I look at the configuration and try to draw a simple line drawing of what I see. If you only write your observations down, without the picture or drawing, you will find it much more difficult to analyze the problem later on.

Put your notes on the drawing. It will make more sense when you are done and later you may need to refer to your notes. If making a drawing sounds difficult, you'll be proud to know that my hand-drawings resemble the work of a 5 year old. That's OK.

> "I have advised technicians, over the years, to "push away" if you want to find the root cause of the problem."

I understand it. Drawing the picture doesn't take long and it will be invaluable in helping me get the big picture later. I don't necessarily focus on detail, but I look for certain things. Don't be surprised at my list. I am just trying to give myself an idea of what's going on and where to look next. My dad told me that "If you don't know where you are going, there are thousands of ways to get there".

The Check-List

1. Identify the operating mode of the compressors — modulating, load no-load, upper-range modulation, VFD, multi-step, or re-circulating to the inlet.
2. Evaluate after-cooler drainage — internal float, solenoid timer, demand drain, and is it working?
3. Signal locations — upstream of the air dryers and where. Is there liquid in the signal line?
4. Check valves — where are they located. If an engineering firm designed the system, they may have checks downstream of the after cooler or wherever. Are they the same size as the line (check valves have a high differential generally).
5. Check for by pass valves and cross over valves. Are they opened, closed, or partially open. Look for the hand valve or rising stem to give you an idea. While you are looking, see if there are any orifice plates between flanges that are either in service or abandoned in place.

COMPRESSED AIR SYSTEMS

6. If water-cooled, is it piped correctly. Is the water counter-flow to the air. Is the water flow manually or automatically throttled or wide-open.

7. Is the room positively or negatively ventilated and what is the temperature and relative humidity

8. What are the inlet and discharge temperatures for the dryers.

9. Check the head and suction pressure and temperature on the refrigerated dryer. Blow-down a sample of air from the after-filter, into a shop rag, and check it to see if the sample has contamination. I will also observe, but not measure, the delta across the clean up. I will also watch the towers, on a desiccant dryer, switch to see if they are transferring smoothly. Does the off-line tower depressurize smoothly.

10. I look to see if the atmosphere is particularly dirty. I wipe my hand on a surface in the compressor room and check the dirt or debris to see if I can figure out what the dirt is. I may ask the client if he knows what the dirt is. I am also careful to pay attention to my sense of smell to see if I detect anything that may be aggressive to the compressor inlet. I also pay attention to my eyes, my nasal passages, and the skin under my tongue because they are the most sensitive areas that I have to detect any acids or caustics in the air such as ammonia or SO2. If I am not sure, I ask if any of these types of things are present. See if there is a boiler, vacuum pump, or combustion process in the same room as the intake for the compressors. I check outside of the compressor room to see if there are trucks parked or if it is a staging are for trucks or tank car unloading. If you find there is a lot of airborne dirt or debris, find out if it has a magnetic charge.

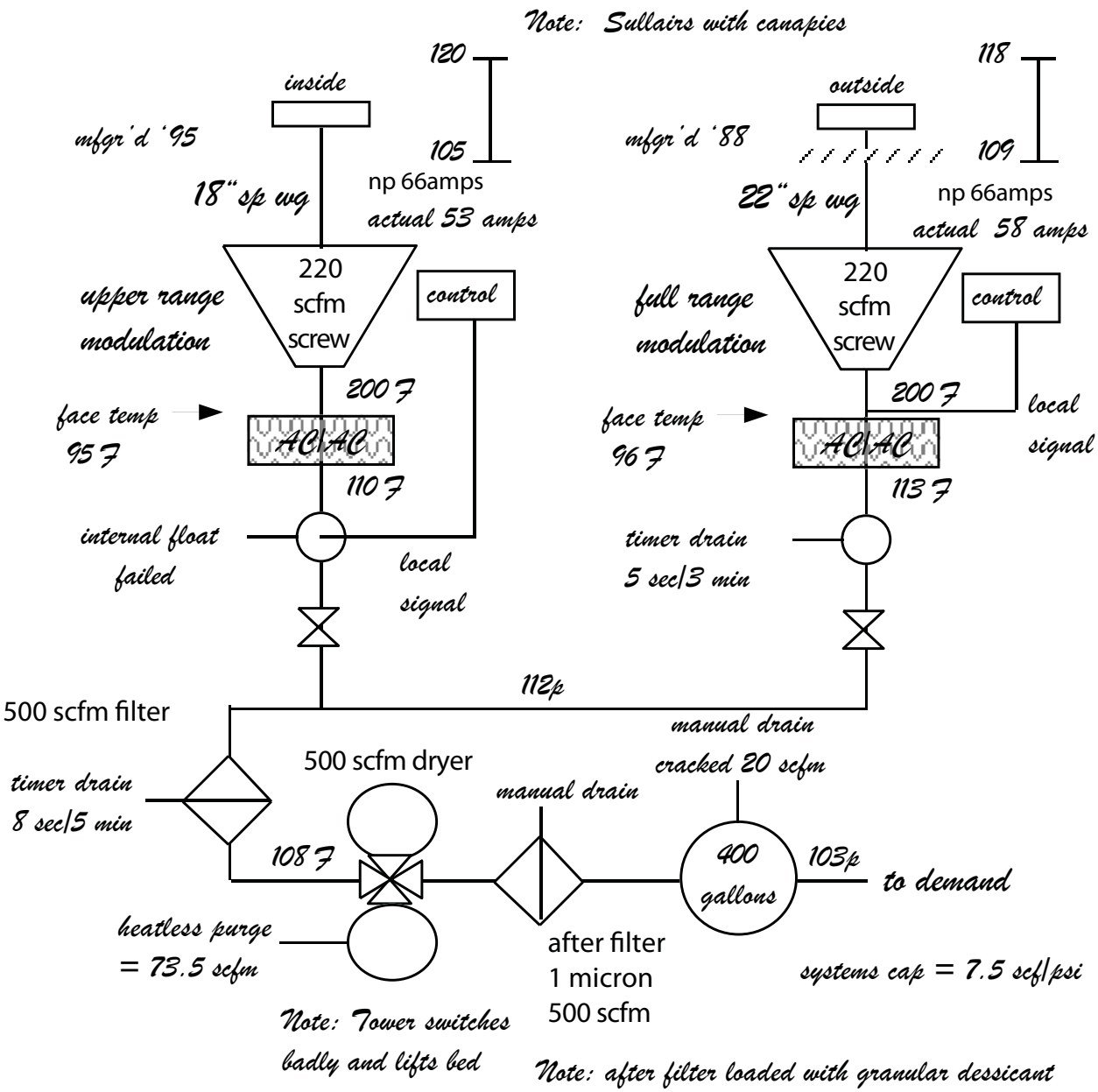
11. Find out what kind of compressor lubricant they are using and what their maintenance change is based on (time or lube sample). Also check the sump temperature or the discharge temperature from the compressor.

With this information in hand, the big picture in a system should be clearer. Individual issues can now be addressed.

For more information please contact Scot Foss, Senior Auditor, Plant Air Technology, Email: airsagas@aol.com, Tel: 704-844-6666, www.plantair.com

TROUBLE-SHOOTING COMPRESSED AIR SYSTEMS *Part II*

BY R. SCOT FOSS



In Part I we reviewed the general approach to entering a compressor room and how to approach the trouble-shooting of the system. We did this at a one thousand foot view, so that we could maintain a system's perspective instead of diving into the equipment or our measuring equipment. We did this so that we would find the root cause problems and not get caught up in the symptoms. In Part II, we review the line-drawing we made and the information we collected.

Let's see what we can learn from the first pass drawing.

1. One compressor is in upper range modulation and the other is in full range modulation. The one in full range modulation has its dead band inside the other. Because the units are under nameplate amps, it is reasonable to assume that they are both more than 25% throttled back. The P2 discharge pressure from the compressors is 112 psig, which confirms the part loading, which we could also determine from the line pressure gauges.

2. Note that the signal on the right hand compressor is upstream of the after cooler. It would therefore read a higher line pressure than the other unit… say 2-3 psig higher. The downstream pressure signal line pressure gauge would be approximately the same as the prefilter inlet pressure.

3. The unit on the right has 22" sp wg vacuum on the inlet filter with an outside inlet filter. The other unit has 18" sp wg and an inlet inside the canopy. Both units are pulling about 5% of the drive capacity of the compressor on the inlet. This would indicate that the compressor performance is poorer than our initial assessment based on actual vs. nameplate amps only.

TROUBLE-SHOOTING COMPRESSED AIR SYSTEMS PART II

> "We will need to trend the temperature to prevent contamination problems down the road."

4. The face temperatures are only one degree off each other with the higher on the right side. This makes sense with the higher power draw on the right unit which would also reject more skin heat from the airend and motor housings.

5. The discharge temps from the two units indicates a 15˚ F ctd on the left unit and a 17˚ F ctd on the right unit. These values are reasonable for the rated ctd's of these units, but we should keep an eye on the right unit. The blended temperature of the two units provides an inlet temp to the dryer of 108˚ F. This represents approximately a 20% higher saturated heat load on the dryer for volume flowing through the dryer. Since the compressors are site corrected 440 scfm and are putting out less that 70% of their rated capacity, and the dryer is rated for 500 scfm, the elevated temperature should not create a problem at this temperature. We will need to trend the temperature to prevent contamination problems down the road. Another indication that the flow at temperature is not likely a problem is that there is drainage waste upstream of dryer which will further reduce the volumetric load. Along with this good news is some bad news. The after cooler float drain on the unit on the left is failed in the closed position, which means that all of the condensate from this compressor is going to the dryer. If you have water downstream, it would be related to this particular root cause issue. You need to get rid of the internal float and replace it with a PNLD type trap. If there was not moisture downstream of the dryer, it would indicate that the compressors are even lighter loaded than anticipated.

6. Please note that the desiccant air dryer is heatless and would have at least 73.5-90 scfm of purge air to atmosphere assuming the purge pressure is set correctly. If it is higher, you would multiply the purge rate times the ratio of the higher pressure divided by the rated pressure. Please also note that the storage tank's manual drain is cracked open and wasting 20 scfm. This is a reasonable indication that they have had water downstream.

7. Let's let logic take it's course and write down what we found:

CONSTITUENTS OF DEMAND	CURRENT	PROPOSED
Production G&B	<134.0	<134.0
Leaks @ 15%	46.0	15.0
Drainage	25.0	0.0
Purge	73-90	<73.0
Artificial Demand @ <10%	30	0.0
TOTAL	**< 308 SCFM**	**<222.0 SCFM**

We have estimated the flow from the two compressors at less than 308 scfm, leaks at a conservative 15%, drainage at an average rate of flow, purge at the lowest rate of flow and artificial demand at a conservative percentage. We have determined that we can probably get one machine off line based on performing a thorough systems analysis including supply and demand evaluation. We have thus far only used our senses, a hand held temperature gun, and local gauges.

Take the drawing back to the office and have someone draw it up with Visio. Record and date the information on a spread sheet and put it in a file which can be used in the future. Determine the locations where you need to install pete's plugs in the system so that you can more accurately determine the actual condition of the system along with signals, differentials, and set points analysis.

This has taken an hour or two at the most and you have been able to take your skill base to a new level of expertise.

For more information please contact
Scot Foss, Senior Auditor, Plant Air Technology,
Email: airsagas@aol.com, Tel: 704-844-6666,
www.plantair.com

JOB MARKET

Job Openings in the Compressed Air Industry

GRS · GRS FLUID HANDLING

REGIONAL SALES ENGINEER (2 POSITIONS)
NORTHERN ILLINOIS/SOUTHEAST WISCONSIN

GRS Fluid Handling is working on a search for a leading company in the fluid handling industry, searching for a top sales engineer, one who can sell products directly to OEM and End User Accounts. For the right candidate, this position could be a terrific opportunity, and will offer:

- Great future promotional opportunities
- A strong company commitment and investment in this position
- A chance to grow and lead as you see fit, building your own projects and plans.
- A strong company that has grown rapidly in the last 2 years.

A technical degree is strongly preferred for this position, as well as 3 to 5 years of sales success with a desire to grow your career.

SALES/PRODUCT MANAGER — COMPRESSORS
SOUTHEAST MICHIGAN/NORTHERN OHIO

GRS Fluid handling is working on a search for a major manufacturer of compressed air products, searching for a top product manager who can manage sales of products to automotive accounts. This position is an Ohio/Michigan based position with several chances for advancement and requires:

- 3-5 years experience selling compressed air/rotating equipment products to automotive accounts
- Ability to travel as necessary
- Residence in or within a 2 hour drive of Detroit
- A technical degree is strongly preferred.

This position offers a chance to advance a career while working for a leading manufacturer. The company is stable, yet growing, and has a history of success.

For more information on these positions, any other positions we are working on, or to learn more about GRS and GRS Fluid Handling's recruiting services please send an e-mail to us at cabc@grsrecruiting.com.

6690 Beta Drive • Mayfield Village, OH • (440) 684-6150 • cabc@grsrecruiting.com
www.grsfluidhandling.com

COCHRANE COMPRESSOR

SALES REPRESENTATIVE WANTED:

As the largest Midwest distributor of compressed air products we have an opportunity for an Industrial sales person. This is an exciting growth opportunity for field sales within your own territory. Position requires the ability to maintain existing accounts and find new opportunities with a specific geography. Knowledge of Mircosoft's XP operating system, Microsoft Office, and customer database management is required. Compensation is a base salary towards draw with no cap on earnings.
This territory with no overnight travel has earnings potential of between $100-150 K. Benefits include company laptop and cell phone, insurance and 401K plan. Send resume via email to **tom.daly@cochranecompressor.com** or fax to 708-345-1339.

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. . . and head for Chicago to attend GRAPH EXPO® and CONVERTING EXPO®, the largest, most comprehensive event for the printing and converting industry in the Americas. ALL your colleagues will be there, where you'll find all the cutting-edge technology and up-to-date information you need to drive your profits to the next level! You can't afford to wait another minute to register for this critical industry event.

Register TODAY at www.graphexpo.com and see where everyone's gone!

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Kaeser SFC compressors:
Taking efficiency to new heights.

In the drive to save energy costs by precisely matching *air production* to *air demand*, Kaeser's Sigma Frequency Control compressors are the most energy-efficient variable speed, single-stage compressors you can find. The competition simply can't compare in performance *or* quality.

Kaeser SFC compressors offer a wider range of operation, from 20% partial load to 100% full load. Plus, our oversized *Sigma Profile*™ airend rotates at lower speeds for greater output while consuming less energy.

With near-unity power factory, built-in phase protection, and superior pressure control, our SFCs are built for a lifetime! And, since we offer them in the widest range of sizes – most with integral dryer options – we have just the right model for your needs. Of course, the best way to appreciate the superior engineering of Kaeser SFC compressors is to see them in operation, so call **800-777-7873** to find one near you.

KAESER COMPRESSORS

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